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FEBRUARY 26, 1945

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Members should notify the Secretary immediately of all address changes

CORRECTION

Re: "A Comparison of the A.A.T.C.C. and Suter Hydrostatic Pressure Testers."

Bottom of column 1, page P40, Jan. 15, 1945 issue.

The following equations used for converting A.A.T.C.C. values to Suter values appear as:

$$S = \frac{A - 4.5}{1.31}; \quad S = \frac{A - 3.7}{1.32}; \quad S = \frac{A - 4.0}{1.32}$$

due to an error in transposition.

The corrected equations are as follows:

$$S = \frac{A + 4.5}{1.31}; \quad S = \frac{A + 3.7}{1.32}; \quad S = \frac{A + 4.0}{1.32}$$

CALENDAR OF COMING EVENTS

Meeting, Northern New England Section, March 16, 1945

Meeting, New York Section, Downtown Athletic Club, New York City, March 16, 1945. Symposium on "Recent Developments in Finishing and their Application to Fabrics." Speakers will be Capt. Goodavage and Messrs. Ackley and Nute.

Meeting, Rhode Island Section, Providence Engineering Society Hall, 195 Angell Street, Providence, R. I., March 23, 1945.

Meeting, Council, Providence Engineering Society Hall, 195 Angell Street, Providence, R. I., March 23, 1945.

Meeting, Research Committee, Providence Engineering Society Hall, 195 Angell Street, Providence, R. I., March 23, 1945.

Meeting, Philadelphia Section, April 6, 1945.

OTHER ASSOCIATION MEETINGS

CANCELLED: Meeting of Committee D-13, A.S.T.M., originally scheduled for March 7 to 9.

Meeting, A.A.T.T., Builders Club, New York City, March 7th, 1945.

FINISHING GROUP MEETING*

(Concluded from last issue)

D. H. POWERS
Presiding

CHAIRMAN POWERS: We are very fortunate in having a man who has had a tremendous amount of experience in the field which he is discussing. He has spent a great many years in the finishing of hosiery. He is going to give us a talk on "Hosiery Finishing and Related Processes," Mr. Siegrist.

. . . Edward J. Siegrist then presented his prepared paper . . . (Applause)

HOSIERY FINISHING*

E. J. SIEGRIST

INTRODUCTION

IF we were to attempt a very thorough and comprehensive study of hosiery finishing, we would find it necessary to include such other phases of hosiery manufacture as throwing, knitting, dyeing, and boarding, as well as actual finishing. I think we all agree that the application of chemicals alone cannot make a good stocking. We agree that unless proper materials and methods are used in these other phases, the application of chemical finishes will be useless. Because our time is limited and also because I feel that the interest of this audience will be better served, my remarks will be confined to the actual chemical finishing of hosiery. We will consider throwing, knitting, dyeing and boarding only if they have a direct bearing on finishing.

HISTORY OF FINISHING

Review of Finishing Materials and Their Functions

Hosiery finishing is a relatively new part of hosiery manufacture. Not until about 1928, only 16 years ago, did the chemical finishing of hosiery become of any great importance. Some finishing had been done, of course, prior to that time, but not as we know it today. The development of materials and the techniques of their application was rather slow in the beginning. Only during the past 6 or 7 years has there been any noticeable branching out in the search for materials with which to finish hosiery.

Among the materials which have commonly been used in hosiery finishing, we have:

Dulling Agents	Resins
Fillers	Rubber Complexes
Stiffeners	Plasticizers and
Softeners	various other
Splash Proofing Compounds	materials

Among the dulling agents, barium sulfate is probably the most commonly used. This material is usually formed by first applying the soluble barium chloride, and later precipitating it by the addition of a soluble sulfate such as Glauber's salt. The result is a deposit in or on the fiber of the insoluble barium sulfate. Titanium and zinc are also quite extensively used in the form of oxides. Whatever we choose, the function is to reduce lustre.

In filling and stiffening agents, we have materials ranging from starches, dextrines, gelatines and gums, to more recent developments in resins, particularly synthetic. With the exception of resins, most of these materials are well known to all of us and need little further discussion. They are generally used in combination with other finishes, and their function is to increase body or stiffness.

In the field of softeners also, we have a great variety of materials ranging from oils or fats to later developments such as the cationic softeners. The unique properties of this latter type of material have made it a very useful tool in the hands of the dyer and finisher, particularly since we have used cellulosic fibers almost exclusively in recent hosiery manufacturing.

Splash proofing compounds or water repellents have ranged from the older type metallic soaps to those more popular at present, that is, compounds of waxes with aluminum salts. A large variety of splash proofing materials has been available to the dyer and finisher. There are a great many ways to produce a splashproofing compound. One of the old methods was to precipitate a metallic soap, such as aluminum, in the fiber by first treating with a soap solution and later with an aluminum salt, or by adding these in the reverse order. From a standpoint of stability in storage, the newer type water repellent, that is the wax type, is much safer as well as easier to use. It must, however, be properly compounded, or a great deal of trouble in finishing can occur.

Splash proofing compounds have several functions. They help to bind filaments to each other; they help to add body; they help to lubricate; finally if used in high enough concentrations, they render the fabric splash proof. The binding of filaments and the lubrication, are in my opinion, more important than the fact that a splash proof finish results. Frazier tests clearly indicate the value of these functions of splash proofing compounds.

Various forms of rubber finish have been brought to our attention in the past few years. The idea of applying rubber to hosiery is not new. Patents have been issued both in this country and abroad, covering the use of rubber compounds or complex emulsions for the finishing of hosiery. Some of the more recent developments in rubber finish have been accepted by the hosiery trade. Unfortunately, the demands of the war have necessarily curtailed certain phases of this work but the field is a promising one, and the manufacturers are on the alert and continually striving for improvement.

Then we have the resins and particularly the synthetic resins; Dr. Powers has just covered this subject in his paper. The impetus given by war needs to this field of research and development is bound to be reflected in the hosiery finish of the future. Some of these resins have properties that ideally suit them to hosiery finishing. It remains for the dyers and finishers to help to improve upon practical applications. Resin emulsions were prepared for use on nylon, and one feature of these compounds was controllable substantivity for the fiber. This control was achieved by manipulating temperature and pH. Such control of exhaustion in a finish bath is very help-

* Presented at Annual Meeting, Atlantic City, N. J., October 14, 1944.

ful to the finisher, and any manufacturer of finishes who builds it into his product deserves a great deal of credit. Some materials need only to be impregnated and cured, and do not depend upon any such affinity for the fiber.

In addition to all these materials there are numerous processed oils and auxiliary products for use either alone or in combination with some of the products I have mentioned. Is it any wonder, then, that some of us have trouble in making up our minds what to use? That brings up the subject of

EVALUATION OF FINISHING MATERIALS AND RESULTS OBTAINED BY THEIR USE

I will touch briefly upon the importance of the laboratory in connection with the finishing department. Just as in dyeing it is almost impossible to get along without a laboratory, so it is in the finishing department. In most hosiery mills these two are combined into one, which is all for the good. Most dyers have learned a great deal about the behavior of dyestuffs in small laboratories and without elaborate equipment. In hosiery finishing, problems arise which make it imperative to have a laboratory at hand. The least we can do is to observe in the laboratory, the behavior of the various materials we use to find out how they react with each other. We can avoid a great deal of trouble by doing this. Of course, rather complete data are available from the manufacturer of finishing compounds; however conditions vary from one dyehouse to another, which makes it doubly important for each dyer and finisher to evaluate materials under his own specific conditions. The type of laboratory I refer to chiefly, is a control laboratory, that is, one which controls application of finishing materials, rather than a completely equipped analytical or research laboratory. Large mills find it not only helpful, but also profitable to maintain fairly complete laboratories, and I think the day is not very far distant when even the small mill will feel the need of a chemical department. While we are talking of laboratories, it might be well to ask another question, that is, "Why do we finish hosiery?"

PURPOSE OF FINISHING

The purpose of finishing hosiery is twofold. First to improve appearance, second to improve serviceability. Under serviceability we might mention fitting qualities as well as wearing qualities. An ideal finish is one that makes a stocking most appealing to the eye over the sales counter, and gives the stocking better wearing qualities than it would have without this finish; both of these properties should last for the life of the stocking. Substantial progress has been made in both directions. We have come a longer way in realizing the first of these objectives than the second. This is true for obvious reasons. It is simpler from a finishing standpoint to improve the appearance of a stocking than to improve its serviceability, because in the latter situation we are dealing with an inherently delicate article and seeking to add to its natural qualities. To make further progress along the latter line we must resort to experiments. A laboratory or department, for physical testing is a great asset to any hosiery mill, not only for evaluating finishes, but for evaluating results of other processes. Unless we have some means of making physical checks how can we possibly tell whether or not a finish is satisfactory? Furthermore, without such means, how would it be possible to compare one finish to another? You might answer, "By actual wear tests." True enough! but any of you gentlemen who have taken the responsibility of collecting data from actual wear tests know that sometimes several months elapse before you get the answer!

Edward J. Siegrist, Superintendent of Dyeing and Finishing, Holeproof Hosiery Co., Milwaukee, Wis., is a native "Milwaukeean" and was graduated from Marquette Academy in 1916. He attended Marquette University during 1918 and began work at Holeproof Hosiery Company in Milwaukee in 1920 as an apprentice in the yarn testing laboratory and dyehouse. He took charge of dyeing at Holeproof's Canadian plant in 1926, and at their Milwaukee plant in 1930. He became superintendent of finishing operations in 1937, and assistant to the factory superintendent in 1943.

He was chairman of the Mid-West Section of the A.A.T.C.C. in 1937 and '38.

PHYSICAL TESTING

There are laboratory methods of testing which yield quite dependable data and are at the same time much more expeditious than the wear test. At times we find it necessary to make changes almost overnight as exemplified by the recent freezing of silk and the resulting necessity of the rapid change over to rayon. Under such circumstances laboratory tests become very valuable.

HOW CAN WE MAKE A STOCKING MORE SERVICEABLE?

Greater serviceability can be brought about by improving resistance to abrasion at points of greatest wear, by correcting stretch and recoverability, and by developing resistance to snagging. These properties can be tested in the laboratory and I will briefly outline the more important tests.

Testing for abrasion resistance is fairly simple. Several devices are available by means of which abrasion can be checked in terms of number of cycles required to produce a failure or hole. Heel, sole and toe constructions are commonly checked by this method. It is interesting to note that a finish can play a decided part in abrasion resistance, either beneficially or detrimentally.

Stretch and recoverability can be checked on a pendulum type tester. This machine is also valuable in checking fabric strength by the ball burst method.

Tests for tensile strength and elongation are very valuable in comparing yarns, but fabrics do not necessarily reflect *all* of the properties indicated in the yarn tests.

A testing device commonly used for checking distensibility, recoverability and stretch endurability is the Frazier machine. Dry harsh "skimpy" fabrics show failures in this test at an early stage, while properly lubricated fabrics of good construction will stand up for several thousand cycles.

One of the important experiments to be conducted in the laboratory is that of snag resistance. Several devices have been developed for this purpose, among which are the N.A.H.M. method and the revolving disc method developed by one of the testing companies. There are also various versions of a sand paper test developed by individual mills or manufacturers of finishing materials, also the pull test which measures the resistance to distortion of an individual loop.

The snag testing device developed at the Bureau of Standards for the National Association of Hosiery Manufacturers is commonly known as the "N.A.H.M." or "Frazier" snag tester. A metal hosiery form with a cut-out portion serves for mounting the test stocking. A metal point protrudes beyond the lower surface of the holder, and this protrusion can be controlled in thousandths of an inch. By means of a special sliding arrangement, the point is drawn over the fabric surface, and a record is made of small, medium, and large or looped snags. This is done for various calibrations ranging from 0 to several thousandths of an inch. The resistance to the pull of a thread or loop is indicated by this machine, and large variations in looped snags are indicated.

I mentioned tests for stretch and recoverability because from actual experience I have found that many finishes which tend to improve snag resistance also adversely affect stretch or recoverability or both. As an extreme example, a stocking could be lacquered and baked and be almost snag proof, but it would no longer be a stocking.

In summarizing, a combination of all of the aforementioned tests will give us quite dependable data. A stocking showing a high rating in all of these tests is quite sure to be serviceable, and by making use of these devices it is possible for the finisher to make an intelligent comparison of finishing materials.

The dyer and finisher today works with a larger variety of fibers than ever before and each of these fibers has its own characteristics. A finish suited to one may give poor results when applied to another. Silk for example had a definite affinity for some finishing materials, which are very difficult to use on rayon. Sometimes this condition may be helped by the use of cationic agents. Nylon again exhibits characteristics differing from both silk and rayon. Thus it becomes very apparent that a knowledge of fibers as well as finishing materials is important.

Now as one finisher to another, I would like to take the liberty of doing a bit of "griping" and also some "wishful thinking." I have often asked this question: "Why must a dyer and finisher very carefully dye a batch of hosiery, match the shade, and then proceed to 'mess that shade up' by applying a finish which will invariably change it." Why can't he dye and finish at the same time, or at least why can't he finish first and then do the dyeing so when he matches the shade, it will be done once and for all? In this connection let me say that a few finishes have been successfully applied before dyeing. The fact that a finish will stand up during the dyeing operation indicates that it is fairly permanent, which is certainly desirable. It is not inconceivable that finishes will be developed for use in the dye bath proper. Some work has been done toward this end. Such a development would not only save a great deal of time, but would also eliminate the necessity of matching and re-matching. It would be folly to consider a combination dye and finish unless a quality finish results. Close co-operation between the finisher and the manufacturer of finishing materials will help to bring some of these things about. Two of the purposes of our Association are, and I quote, "To promote increase of knowledge of the application of dyes and chemicals in the textile industry," and "To provide for its members, channels for the free exchange of ideas and professional experiences for the benefit of the industry." Consequently one of the best ways to contribute to the welfare of our Association is to help each other.

I take this opportunity to thank Dr. Powers and his committee for their very kind co-operation, and to thank you gentlemen for your considerate attention.

DISCUSSION

CHAIRMAN POWERS: I would like to raise one question. That is this: if you had the choice of a finish that improved the appearance slightly or a finish that doubled the wear but hurt the appearance, which would you take?

MR. SIEGRIST: It would depend upon what kind of stocking I started with. I think serviceability is certainly important but we can't forget the ladies. They are the judges. The best selling rayon stocking is without a doubt a 50 denier and it doesn't wear like a 100 denier. If we talk to a group of men about serviceability that is one thing, but if we talk to the women that is something else.

HAROLD SIDNEY: Judging from the immediate treatment given a pair of stockings by the consumer, it would hardly seem possible that you could put on any finish that would be permanent. She evidently doesn't like the finish that is on there and, therefore, attempts to wash it out. I think there are two considerations there: One is the retailer and one is the consumer. Whether you could tie up the two together, I don't know. It would be a good thing if we had this permanent finish all the way through.

MR. SIEGRIST: I think we should qualify that statement. You raise a very good point. I know that a lot of women wash their stockings before they wear them, but doesn't that depend upon what kind of finish you had to begin with, whether it was desirable or undesirable? I think that is important. If it is the feel and appearance that she wants, she won't wash them.

MR. SIDNEY: My contention is that what the retailer wants is not what the woman wants. I don't think you can tie the two together, because the retailer wants a stocking that will lay smoothly and, therefore, it has to be built up, while the woman doesn't care for that buildup. Whether you can combine the two or not, I don't know. It wouldn't seem so.

MR. SIEGRIST: No, it wouldn't seem so in all cases, but I think in some cases it would.

JOSEPH F. FEIT: Mr. Siegrist, a number of years ago there was an epidemic of dermattitis supposedly caused by finishing on hosiery, and other types of material. I am going to ask whether or not you can throw any light on what type of agents generally have been responsible or what type of agents are offensive and should be avoided in finishes of hosiery.

MR. SIEGRIST: I am not sure that I could answer that. I don't know of any specific product that was responsible; I have heard the same things about various finishes as you have, but I wouldn't like to make any statement on that without authority.

GEORGE MELVIN COOPER: You say that there were two products that you knew of that could be applied prior to the dyeing. Would you care to elaborate on that a little bit?

MR. SIEGRIST: I don't think I would right here, no. (Laughter) I could tell you that one of those products I mentioned was a rubber finish. Since there are several, I wouldn't care to mention right here which one it was, but it was successfully applied before dyeing. Another one was back in the silk days. It was really a splashproof and dulling finish, combined. It happened to be my own. (Laughter) So we won't talk about that.

ALBERT GRIMSHAW: Would the lab that you speak about be equipped with equipment for splashing and washing tests?

MR. SIEGRIST: Yes.

MR. GRIMSHAW: What type of equipment?

MR. SIEGRIST: That would come under your dyeing department, rather than finishing. That is the reason I didn't mention it.

MR. GRIMSHAW: I was going to ask then whether some of these finishes that you are speaking about wouldn't interfere with the dyeing.

MR. SIEGRIST: Some of them will actually increase wash fastness. Some will not. Very often when you get a large or a great change in appearance with the finish, unless that finish is permanent, it naturally follows that you will get a greater change from your wash.

CHAIRMAN POWERS: With the war effort sending cotton goods all over the world, we suddenly discovered that fabrics that may be satisfactory under use in this climate failed and failed quickly under conditions in the tropics. As a result, there was a study set up to find out if the tropics were different, were the conditions just the same as we have only faster, or was there an entirely different problem that we had to face? Did we have to start all over again in developing fabrics that would stand up in the tropics?

In studying the problem at this time it is natural that we turn to a man who is an expert. The Army has been tackling this problem and Dr. Weston of Harvard has been doing a tremendous amount of work for them. We are very fortunate in having Dr. Weston. Biologists all over the country say, "Yes, we have heard of his work," but the textile chemists don't know anything about it. So we are very fortunate indeed to have him come and tell us about his work.

DR. WILLIAM H. WESTON: Mr. Chairman, Members: I feel highly honored that you should want me to join you. I am a rank outsider in a limited field.

. . . Dr. Weston then presented his prepared paper. . . . (Applause)

PROBLEMS IN THE NATURE AND CONTROL OF TROPICAL DETERIORATION*

WILLIAM H. WESTON

THE broad general problem of tropical deterioration is so complicated in character and so extensive in scope that it touches the interests and activities not only of this association but also of many other groups in civilian phases of the war effort and in the army and navy. During the past two years the problem has made itself felt increasingly until it has aroused general and wide spread concern. This doees not indicate that the problem itself is a new one for it is one of long standing; rather the indications are that changes in conditions involved in large scale military operations in the tropics have introduced additional factors that have notably increased its severity. The most important of these factors are the following:—

1. Vast amounts of material, valuable in itself, doubly valuable because of the cost of replacement, and triply valuable because of its importance in military operations have been exposed to the most severe conditions.

2. Much of this equipment is infinitely more complicated than anything so exposed in the tropics in the past, its construction in encased assemblies precluding adequate care of essential but susceptible parts, its precision requiring maintenance of delicate adjustments.

3. Field operations requiring establishing tropical beachheads and fighting toward the interior have of necessity involved very severe conditions of exposure.

4. The urgency of these military operations has prevented giving adequate protection to some items for weeks or even months.

Since textiles are the primary concern of most of us here, the general problem of tropical deterioration may best be considered in relation to them. The severity of the conditions to which heavy textiles like tentage and tarpaulins are subjected is extreme. After manufacture, finishing, and fabricating they have undergone long periods of storage and transportation. The long journey across the Pacific in the hold of a vessel has involved extremes of temperature running as high as 150° or 160° F. in an atmosphere usually sufficiently moist to permit some droplet condensation during rapid changes. After further handling and transportation the material has reached its destination often under the severe conditions of combat landings noted above. Finally the tent is pitched and its exposure to the tropical environment officially begins.

While this tropical environment varies considerably in different localities, its two ever present components, the climate and the many organisms fostered by the climate, form a combination that is, in general, severely destructive. While the temperature is relatively even, ranging from around 78 to 95° F. in the shade, it may drop at night to as low as 70 or even 65° near forested mountains and during the day, if in the sun, the tent will be baked at 140 or 150° during several hours. It will be surrounded by air with a relative humidity from 85 per cent to saturation and during the rainy season it will be beaten by torrential rains amounting to as much as 200 or 300 inches in six months, with little if any chance to dry out. Even when not subjected to such extreme downpours, it will be dripping wet in spots as slight changes in temperature result in condensation particularly in the inside in the peak of the tent where ventilation is not adequate, and it will be damp to dripping inside and out most of the night. In the monsoon belt, if pitched in the open along the seashore or on the coastal plain, it will, through the several months of the dry season, be sun-baked during each day and damp by condensation each night. In the dense, dank jungle of the real rain forests it will be unremittingly damp to dripping throughout the year. It will be surrounded, besieged and attacked by unresting hordes of hardy and aggressive lower organisms, some actively destructive, some slightly detrimental, some neutral, but all well adapted not only to survive but to thrive and multiply under tropical conditions. To some of these it will furnish food, to others sheltered hiding and breeding places, to still others highways, points of vantage, and flying fields. From the air, from dust, from material splashed, dripped, or dropped on its surfaces, vast numbers of spores or other microscopic reproductive bodies of various low forms of plant and animal life will be deposited to hatch or germinate and start their rapid growth. Thus even on its upper panels it will accumulate a microscopic but fertile soil while through contact with the earth as well as from spattered mud it will acquire some of the multitude of soil organisms that constitute the most complex microbial population known to science.

In this complex of environmental factors, both non-living and living, lie the causes of tropical deterioration. In part the chemical and physical factors of the non-living environment are responsible, and one school of thought considers these to blame for practically all of the trouble encountered. The other school of thought considers the living agents, chiefly fungi and bacteria, secondarily insects, mites, and other lower animals, either separately or in sequences and combinations, as primarily responsible and offers strong supporting evidence by experimentally reproducing severe deterioration with such organisms under controlled conditions. In my opinion the evidence now available justifies the conclusion that at least in the case of textiles derived from plant and animal raw materials, textiles such as the cotton duck we are considering, deterioration results chiefly from the action of fungi and bacteria.

This conclusion leads us to the consideration of subsidiary problems such as the original source of these agents destructive to cellulosic textiles, and the identity and characteristics of those causing the destruction of such textiles in the South and Southwest Pacific theatres.

The source and origin of the fungi attacking cellulosic fabrics is fairly clear. They are, in the main, saprophytic, decay producing molds and mildews originally occurring on leaves, stems, and other cellulose containing plant remains. This general situation is one of long

* Presented at Annual Meeting, Atlantic City, N. J., October 14, 1944.

standing for cellulose and its derivatives developed early in the evolution of the plant kingdom and have continued ever since as the main structural constituents of plants, while certain fungi, early in evolutionary history developed the ability to use these carbohydrate materials as their chief sources of carbon. Thus fungi have played an important part in nature for millions of years in breaking down complicated plant remains, rendering the constituents of cellulose once more available in simple form in the vital cycle of organic materials, and thus from the broad biologic viewpoint they have been beneficial to man as well as to other living things. This breaking down of complex materials to simpler components as sources of their carbon, nitrogen, minerals, and other raw materials is an essential step in the nutrition of all fungi and is accomplished by the batteries of powerful enzymes, the production of which distinguishes the fungi as minute chemical factories of the highest efficiency, versatility, and diversity. Obviously the organisms chiefly responsible for tropical deterioration for millions of years have put into practice the modern slogan "Better things for better living through chemistry" for they were gaining a good living through their chemical activities when Wilmington, Delaware, was a steaming carboniferous swamp crawling with dinosaurs.

Although this disintegration of materials, in its grand biological strategy, is advantageous to man, certain aspects of it are distinctly disadvantageous if not downright antagonistic for the fungi all too successfully compete with man for the materials he has spent time and money in manufacturing and quite naturally wants for his own use. For these organisms it has been an easy transition from the difficult task of extracting food materials from relatively resistant plant parts to securing such nutrient substances from relatively vulnerable manufactured materials such as the cellulosic fabrics. Similarly, although from the activities of somewhat different sets of fungi, these destructive activities extend to such other manufactured cellulosic materials as wood pulp, paper, wall board, ply wood, and cellulose nitrate films. It is a great credit to the ingenuity and resourcefulness of the chemists of organizations largely represented here that this persistent competition has, in part at least, been successfully restrained.

To the next question, that of the nature and identity of the fungi chiefly responsible for the deterioration of textiles in the Pacific theatres the answer is not yet final. A-priori there are two main possibilities (1) that the fungi are of the same general type as those causing similar destruction in temperate climates but much more active under the more favorable conditions of the tropics; (2) that at least some of these organisms are different in identity, essentially more formidable and destructive in character, their effects accentuated by favorable conditions.

Dr. William H. Weston, Biological Laboratories, Harvard University, holds degrees from Dartmouth College and Harvard University. He has been a member of the faculty at Western Reserve University, Lowell Institute, Johns Hopkins, and at Harvard where he was head of the Botany Department from 1925 to 1932. He has long been associated with the U. S. Department of Agriculture and has done important investigational work on tropical plant diseases in the Philippines, Cuba, Guam and Panama.

Dr. Weston has published much important fundamental work in this field. He is a member of many scientific and technical societies. His vast experience eminently qualifies him for the fine work he has done for the War Department on the control of tropical deterioration of material.

Some information has accumulated from outstanding work in the Pacific theatre by the Australian scientists and from analyses of returned materials by the Canadian Research Council, by our Department of Agriculture, and by other laboratories in this country and elsewhere. Realizing the need for additional fundamental data, the Research and Development Branch of the Office of the Quartermaster General, in its comprehensive program for the study and control of tropical deterioration has secured from various representative points in the south and southwest Pacific areas numerous sets of samples of deteriorated materials, accompanied by significant reports and other pertinent information. Although work on this material in the Tropical Deterioration Research Laboratory at the Philadelphia Quartermaster Depot is still in its initial stages, preliminary findings have already added significant supplementary information to that previously accumulated.

The evidence now available lends some support to each of the two possible interpretations and, to avoid fatiguing you with technical mycological details, may be summarized briefly as follows. The assumption that the same general array of molds causes deterioration in the tropics as elsewhere is supported by the frequent occurrence among the isolations from tentage and tarpaulins of the Pacific theatre of several of the same genera and even of the same species that are notorious for injury to such materials in this country and England. As might be expected also the familiar superficial molds are common on Pacific tentage as they are on the most diverse materials in almost world wide distribution. Yet on the other hand, the alternate assumption finds support in the presence of some genera and species which are rather unusual, distinctly different from the usual isolates and of fairly common occurrence under conditions indicating they probably play a significant part in the deterioration of the textile samples.

As the tedious and technically difficult task of determining the identity and analyzing the destructive activities of these casual agents responsible for tropical deterioration continues to progress in many laboratories from Philadelphia to Sidney, Australia, the information which accumulates will prove of the greatest practical value. Even now we have ample evidence that in the field of tropical deterioriation even of textiles such as tentage we have to contend with a complex, diverse, versatile, and generally formidable array of molds. Some of these are superficial mildews, rapid in development and highly efficient, their great physiological diversity enabling them to obtain their nutriment from the most unlikely and varied materials, hence capable of destroying the waterproofing of the tentage and of reducing the copper content of mildewcides to below the lethal minimum essential for protection. Others are highly efficient destroyers of cellulose, capable, once they have gained access to the fibers through microscopic crevices, of breaking them down rapidly under favorable conditions of moisture, temperature, and availability of accessory nitrogen sources of nutriment. All of them are prolific in multiplying themselves, hardy in endurance, aggressive in activity, well fitted for survival under a wide range of conditions. Although for precise results we study them singly in pure cultures, under natural conditions they occur in multiple mixtures or complex successions of populations, their interactions being intricate and of great biological and practical importance. They may compete among themselves as they do with other organisms (from bacteria to chemists!) and the subtleties of their antibiotic action we are just beginning to appreciate through the study of such therapeutically

valuable antibiotic substances as penicillin. They may collaborate, either successively, one by its activities preparing the way for another, or jointly, accomplishing in combinations what neither component could achieve separately.

In addition to the molds, mildews, and other fungi on deteriorated tentage there are bacteria, of which several types have been found occurring frequently on the samples secured by the Office of the Quartermaster General from the Pacific theaters, the conditions of their occurrence justifying the suspicion that they may participate in the deterioriation.

If you are thinking that this general picture is being presented as unduly complicated because the enthusiasm of a technical specialist leads him to revel in the delightfully nauseating aspects of this whole happy nightmare, let me reassure you that there is ample evidence to support my statement, and that problems involving equally complicated situations have been solved in other fields and let me remind you that the enemy should not be underestimated, intimate knowledge of his capabilities being essential to the grand strategy and detailed tactics for his defeat.

The final problems we must consider are those involved in our major objective of control. The approach to the prevention of tropical deterioration has mainly been one of applying promising preventives developed by the chemical industry, using methods of application adapted to the usual machinery and processes of the textile industry. Through this approach notable advances have been made and some of the treatment developed and applied show great potentialities. If they were wholly successful, the problem of the control of tropical deterioration of textiles would now be only of historic interest and would no longer arouse concern. Unprejudiced examination of numerous reports from the Pacific theatre and of samples of tentage in use there only three months, yet severely deteriorated, shows convincingly that the problem still demands attention.

Concerned in the problem are the textiles themselves, the finishes, and other chemical treatments they receive, the action of the living and non-living tropical environment to which they will be subjected. Hence the answers will require the co-operation of textile experts, chemists, mycologists, and bacteriologists. Since these are all represented here and this Association has played an important part in textile research and development, this is a favorable opportunity for considering how the situation may most effectively be met. Since the atmosphere in these meetings fosters open discussion and productive controversy, perhaps it will not be unduly presumptuous if I bring up a few questions as to possible lines of attack on the problem.

The most pressing questions are involved in the treatment of cellulose textiles such as tentage for prevention of deterioration. Of the three essentials (1) suitable moisture, (2) favorable temperature, and (3) available food material on which the development of molds depend, it is obviously only the third that offers possibility of control under field conditions in the tropics. Fungous spores, invisible, but ever present in vast numbers, can not be actively driven away by repellents as can destructive insects, and the tentage inevitably will acquire thousands of them. Is it not possible that the present method of treating such textiles defeats its purpose by attempting to do too much in one operation? May not the application of flame-proofing, water-proofing, and mildew-proofing agents in one bath with squeeze rollers reduce the efficiency that would be attained if the mildew proofing were applied first and the other proofings later in a two or even three bath procedure? Marked differences in mildew resistance between one panel of a tent and the next as often observed certainly seem to indicate lack of uniformity of treatment by present methods. Bear in mind that the fungous spores that are continually reaching the tentage will remain there, persistent, and long enduring, ready to penetrate and destroy when the barriers you have applied become inadequate.

The reasons, such as inadequacy of equipment and impractical complication of efficient manufacturing procedure, offered in support of the present method, are adequate in the case of one plant producing a rush order now but not for the whole industry indefinitely in a country that has met greater manufacturing difficulties in producing materials such as synthetic rubber.

The continued effectiveness of mildew-proofing compounds under long exposure involves continuing endurance of the preventive power of these compounds against the destructive power of incessantly reinforced hordes of fungus spores. In general the action of mildew-proofing compounds may be either fungistatic, preventing fungus development, or fungicidal, killing the fungi that come in contact with them, or neutralizing, rendering the fungi impotent by paralyzing or counteracting their enzyme systems. In opposition the action of the fungi is to deplete, counteract, combine with and generally wear down the mildew-proofing and in this they are aided by other living and non-living components of the tropical environment. There is need for further knowledge of the biochemical activities of fungi in relation to the protective action of mildew-proofing compounds and various laboratories are working on this difficult problem. There is need also for further research on the methods of mildew-proofing textiles and the laboratories affiliated in this Association have the skill, equipment, and incentive to prosecute this. Is it not possible and even practical to impregnate effective and enduring mildewcides into the yarns themselves rather than onto the completed textile after weaving? May it not be possible and practicable to affix such substances to the cellulose of the cotton fibers in intimate attachment in the manner of substantive dyes? Since cellulose itself is so vulnerable, is it not a practical approach to attempt to render it chemically unavailable to molds yet still retain its desirable qualities for textiles as cellulose acetate is unavailable yet retains the desirable plastic qualities of vulnerable cellulose nitrate?

In conclusion, the comprehensive and complicated nature of the important problem of tropical deterioration should again be emphasized. Its many aspects touch most of the interests and activities represented in this Association. Collaborative action toward its solution will be far more effective than the efforts of any one specialized group. The more agencies, industrial, governmental, and institutional, attack its various aspects, the better. The inevitable duplication of effort, viewed with alarm by some is inevitable, since present conditions prevent co-ordination under one direction and in the long run may well prove advantageous. Although the problem has been accentuated by the exigencies of this war, its importance will continue in the inevitable development of tropical resources which will follow. If, along with the many problems that have been considered at these meetings, this problem of tropical deterioration receives its share of attention from the highly competent, technical groups represented here, it is safe to predict notable progress towards its solution will be reported.

DISCUSSION

CHAIRMAN POWERS: Thank you very much indeed, Dr. Weston, for your enlightening, entertaining and excellent talk. It certainly seems reasonable that if the fungi and the bacteria can co-operate, the human race ought to be able to co-operate enough to solve this problem.

Incidentally, one question I would like

to raise: Are we justified in using the present test organisms for this work on the basis of the work that you are doing?

DR. WESTON: It is very interesting how it shows the length of time it takes to appreciate a problem. As I said, the Australian Micrological Panel have been working on this for nearly two years. Out of the 130 organisms which they found chiefly concerned in deteriorated materials, they have picked out some 40, which they were good enough through their representative, Dr. Whiffen, to send over here for our use.

We have compared those with some that we have in this country. We have here, not derived from the tropics, a metarrhizium that you have all seen mentioned in the literature and used by the Greathouse and others. This is one of the most destructive organisms that's known in the tests we have carried out. So the choice of the testing organism is not only dependent on its breaking-down-ability, its destructibility, but perhaps to some extent on the region to which the material is destined to go.

The Army practice is to treat a thing inclusively for any region, and that is probably sound. So we will undoubtedly come ultimately to the choice of test organisms that will amply embrace the most severe ones and settle on that. There is a committee working on that —I think some of your men are in liaison with it—a committee on the choice of procedure and organisms in testing.

MEMBER: When these different organisms attack and break down cellulose—is the degradation product always the same, or are they entirely different?

DR. WESTON: We don't know yet. Some apparently act in the same way, as far as we can tell from the end-point reached, but the complicated steps in breaking linkages we really don't know. They produce acids, they have batteries of enzymes and there are other by-products. One will use these to build up and change the by-product of another so it becomes more effective.

I would not pretend to say whether the degradation is the same in all cases but quite a bit has been done and there is some evidence that the mechanisms and the degradation products differ with different organisms.

H. NECHAMKIN: You have been speaking of degradation of cellulose by these molds and bacteria. Has degradation of wool and synthetic fibers been studied and observed?

DR. WESTON: You are getting a bit out of my field, but there has been quite a bit done. Nylon is much more resistant, but we have disquieting reports of some molding of nylon materials. Wool is tougher, but there are certain bacteria that will break down wool quite effectively. It is basically keratin, which is tougher in a sense than cellulose, but can be broken down. Certain plastics are exceedingly invulnerable as far as we know, but I wouldn't put it past some combination of molds to etch or gradually injure those, too. The plastics are exceedingly inert and relatively invulnerable so far. The funny things about nylon is that in it there are the basic materials that a mold needs, but they can't seem to unlock it to get it out.

DR. LELAND SHANOR: I was very much interested in Dr. Weston's remarks with reference to these numerous organisms that we find on materials. That brings up a question in testing that I would like to put to Dr. Weston. We have testing methods now, pure culture techniques as well as mixed culture techniques.

In these laboratory tests, do you think that by using mixed cultures we will obtain more reliable results in making our interpretation than we can by applying pure culture techniques?

DR. WESTON: That has two aspects, Dr. Shanor. In our field of work, as you know, the ideal is to reduce a problem to its simplest terms. That calls for pure culture for then you know just what you are doing for you have one organism under controlled conditions and you can see what it is doing. Nature doesn't work that way and doesn't use pure cultures.

However, until you could tell me what combination or organisms is operating in Oro Bay, New Guinea, as opposed to Santo Esperitu in the Hebrides, I wouldn't dare say. The ideal combination in a mixed culture test should tell you the whole story. I hope we can find something like that. That is what your testing groups are trying to do. If we can just approximate an ideal combination that would give the worst possible collaboration—the best possible collaboration from the point of view of the fungus, the worst possible end result, we would be able to use it to advantage.

DR. SHANOR: I have one more question. I know it is one that has interested the group. You have had experience not only in the Philippines but in Panama and the adjacent area. Do you feel that the deterioration in the Panama area is less severe or comparable to that in the Philippines and the South Pacific region?

DR. WESTON: It is comparable, Dr. Shanor, the difference being a matter of degree. I was there seven months during the rainy season, which was terrific, and then on into the dry season, and it compared very favorably in luxuriance of fungus growth and severity of breakdown with the Philippines. However, there are some areas in the Philippines where it is dripping wet all year around. The rainforest in that Pacific area is just constantly dripping; everything is just coated with moss. Molds will hang, unshaking, in utterly still air as if in a greenhouse, sporuliating exceedingly. We don't get that much rain in Panama. Going into the interior, in that upland plateau where you have dense forests, you will approximate it, but for two or three months even that will be relatively dry.

MR. YOUNG: Do mildewproofing agents such as copper or zinc napthenate tend to destroy some, few or most of these fungi that you have tested? That is one question. The other question is: Do these mildew proofing agents tend to work with any degree of success in the Pacific climate?

DR. WESTON: If I had known the answer to these questions we could adjourn happily. (Laughter.)

As to that first one, copper napthenate is very promising, but some things will lower the concentration of the copper there to below the lethal minimum and in some respects it doesn't stand up as well as others. However, I must say that the deteriorated material that has come back from the front was not copper napthenate treated.

On that second point, I wouldn't pretend to say, really, but we hope to find out. You see, the OSRD has been most cooperative. Their group planned to send a mission to the Pacific to test out materials which had been carefully tested at the Philadelphia and Jeffersonville depot and give them actual exposure under Pacific island conditions and in Panama. That mission was cancelled and they are being tested in Panama only. They will get some information from that.

It is surprising how behind we are. It is to the shame of my colleagues and myself and it is to the shame of some of you fellows here that we haven't realized it. Some of the aviation companies that work in the tropics have, but not enough has been done in the tropics.

MR. DANNERTH: Haven't these conditions existed for the last fifty years? (Laughter.)

DR. WESTON: For the last two hundred. (Laughter.)

MR. DANNERTH: What are the natives in that territory doing?

DR. WESTON: In the Philippines they get around deterioration very nicely. There are large quantities of easily used materials, bamboo for walls and ipil posts that will withstand the termintes. You

build your house with those. When your thatch begins to go, you rip it out and put on more. Labor is cheap.

Why should you fabricate a complicated house of expensive materials needing protection against deterioration when you can build of readily available raw materials easily replaced. That is their point of view.

In some cases the Australian army has built storage bodegas that are comparable to the native huts and stand up very well.

DELIA MARSHALL: Do you think you get similar results on running that test on filter paper as well as canvas itself?

DR. WESTON: Filter paper is pure cellulose, much more pure than duck. There is an interesting thing about cellulose. You find me an organism that will thrive on cellulose alone. There just aren't any, they have to have a nitrogen source somewhere. So it is the additional things that make growth possible, but they don't require much. They require much more of carbohydrates than they do of nitrogenous material.

Filter paper is of looser texture, not so tough, and purer cellulose. However, it is a very comparable substance and Dr. Greathouse and others used it.

MISS MARSHALL: It would compare about the same?

DR. WESTON: Yes.

MEMBER: Would you care to comment on marine microbiological damage to cellulose? How does that tie into this?

DR. WESTON: Under water you mean?

MEMBER: Alternate under water, where it has opportunity to dry and probably during the drying process come up to relative humidity and temperature conducive to growth.

DR. WESTON: Dr. Barghoorn, who is now with the OSRD in Panama, found under water an interesting set of organisms we hadn't dreamed of before, that are submerged, aquatic fungi breaking down cellulose and other compounds in the wood and in cordage, too. In general, I think it would favor degradation rather than inhibit it to have the stuff dunked in salt water and then dried on land.

MEMBER: It is your opinion, then, that the laboratory sea water test for the evaluation of resistance to marine microbiological growth is useless?

DR. WESTON: No. How do you get that? (Laughter.)

MEMBER: I mean, you take the synthetic sea water as the AATCC formulates it; it just can't have the marine growth in it and the micro-organisms in it so that laboratory test is not worth much.

DR. WESTON: I see what you mean. This is synthetically made?

MEMBER: That is right.

DR. WESTON: It lacks the characteristic marine flora that would accomplish degradation.

MEMBER: Right. Let us take sea water that you get in the Atlantic Ocean and keep it in your laboratory for six months. Apparently, that isn't an awful lot better.

DR. WESTON: For bringing in the organisms?

MEMBER: Yes.

DR. WESTON: They would die out.

WILLIAM L. BAUMNER: Do you find Japanese textiles resistant in that climate?

DR. WESTON: We haven't gotten back too much, sir. There are some captured Japanese articles that are being analyzed and they are being analyzed from every point of view, as well as deterioration. So far, nothing is outstandingly, strikingly better than ours.

CHAIRMAN POWERS: Dr. Weston, has there been anything done as a means of preventing mildew and fungus by attacking with enzymes; in other words, destroying the enzyme or precipitating it?

DR. WESTON: That is your third approach. One is fungicidal, killing the spore or the mildew. The other is fungistatic, inhibiting. The third one is neutralizing or locking up the enzymes. They have done some work with controlling the soil-inhabiting, root-rotting parasitic fungi thus.

CHAIRMAN POWERS: In your opinion, isn't that a promising approach?

DR. WESTON: It is; but all of these should be tried. The other remaining method which can be used with insects, that of repelling the insect, just doesn't work with fungi. They won't fly away. You can't repel them. They will settle right down and wait. You have to kill them, inhibit them, or neutralize their activities.

CHAIRMAN POWERS: Thank you very much, Dr. Weston. We are very much indebted to you for this excellent report. (Applause.)

We now come to the fourth and last paper of this morning's session. Our last speaker is a man who should need little introduction as he has long been in touch with the textile industry, as he has been a technical director of the National Association of Dyers and Cleaners. I think he tried to make himself a little aloof by this title. I hope he will explain to us what he means by "Water Impedient Treatment and Retreatment of Clothing Fabrics." Lieutenant Fulton of the U. S. Navy.

LT. GEORGE P. FULTON: Thank you, Dr. Powers.

Ladies and Gentlemen: That is a fine title, I must admit. It was suggested to me by a member of the Committee. (Laughter.) So that is why I used it.

. . . Lt. Fulton then presented his prepared paper . . . (Applause.)

WATER IMPEDIENT TREATMENT AND RE-TREATMENT OF CLOTHING FABRICS*

LIEUTENANT G. P. FULTON, SC, USNR

ALL branches of the armed services have made extensive uses of water repellent fabrics. The increased comfort and wearing qualities of water repellent garments as compared to waterproof garments make them quite desirable except in extremely foul weather where obviously a waterproof material is necessary. Demands of the armed forces have necessitated considerable research, with the result that a great deal has been added to our knowledge of water repellents during the past few years. Private industry has given help and cooperation which have been of great value to this work. Improvements have been made in the fields of water repellency, and much interest has been aroused so that many now realize that this is indeed a fertile field for further research.

Water repellents may be classified in several ways but probably the most widely used classification at present is based on the durability of their performance on the fabric. Such a classification includes three types: durable, semi-durable and non-durable. These types could be further subdivided with respect to their method of application—that is whether they are applied in an aqueous or organic solvent.

The durable type may be defined as one which will impart satisfactory hydrophobic characteristics to a fabric which will persist throughout the life of the garment

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and survive the normal cleansing operations to which the material will be subjected. The non-durable type may be defined as one which will impart satisfactory hypdophobic characteristics to a fabric which will persist until the garment is laundered or dry cleaned. The semi-durable type is one which will impart satisfactory hydrophobic characteristics which will not persist throughout the life of a garment, but which will survive one laundering or dry-cleaning.

The definition of durable type is somewhat general since some garments will be subjected to more wear and cleansing processes than others. It should be pointed out that cotton garments are usually laundered while most wool and many rayon garments are normally dry cleaned. Several years ago it was shown (1) that, in general, dry cleaning is more apt to decrease hydrophobic characteristics than is laundering. Recent work by the Army Quartermaster Corps has demonstrated the detrimental effects of repeated drycleanings on garments treated with durable repellents. This work has also shown that the durability of repellents in use today varies over quite a range. Although the three classifications are satisfactory at the moment, they may prove inadequate as a future method of classification. Possibly some numerical system of rating will be devised which will indicate more specifically the durability of water repellents.

Producers of water repellents, water repellent fabrics and garments, must face the fact that garments will eventually require cleansing, sometimes numerous times throughout their life. Cotton fabrics are apt to be laundered, but if they contain wool linings they are more apt to be drycleaned, for laundering makes subsequent pressing more difficult and increases the possibility of shrinkage of the wool lining. In the event that they contain a wool lining and are badly stained with grease, then drycleaning becomes necessary, for the ordinary laundry procedures drastic enough to remove the grease from the cotton would damage the wool. This is the case with the Navy Winter N-1 outfit which usually becomes badly stained with grease aboard ship. In the civilian trade, reversible trench coats often must be drycleaned because of a bright fugitive dye on the lining which, if washed, will crock onto the cotton portion of the garment, or because of an improperly preshrunk wool lining, which if wet out will shrink more than does the cotton fabric.

Commercial drycleaning often decreases the hydrophobic qualities of a fabric treated with durable water repellent much more than the laboratory test where fabrics are immersed in the solvent in a launder-o-meter jar. When garments are badly soiled, drycleaners employ a drycleaning soap in the solvent. Such soaps are usually water-in-oil type emulsions containing soap, free fatty acid, and often some homogenizing solvent. Subsequent rinsing with the solvent usually fails to remove minute traces of this soap which thus remain on the garment and counteract the hydrophobic qualities of the repellent. Unless the solvent is new, or has been distilled immediately prior to its use, impurities accumulated in the solvent from previous cleanings often decrease the hydrophobic qualities of the fabric even when no soap is used.

Obviously if satisfactory repellency is to be retained, garments containing repellents of the non-durable type must be retreated when cleansed. Garments containing the semi-durable, or even durable, types will lose some of their hydrophobic qualities through wear and repeated cleansings and thus they too will often benefit by retreatment. In this connection it should be stated that the fabrics originally treated with a durable type repellent appear to obtain their original degree of repellency more easily upon retreatment. Retreatment may be in water or in organic solvent such as Stoddard solvent, depending on which type of cleansing is employed.

In the event cleansing is by laundering, retreatment is usually done in water since the garment is already wet out and this method is most convenient. Laundering is carried out in a revolving cylinder, known as a washer, in which the garments are agitated with water, soap and often some alkaline salt to increase detergency. Usually garments will be subjected to several such cleansing operations, followed by several rinses of clear water and, finally, by a rinse containing some weak acid known in the trade as the sour. During all these operations the garments are not removed from the washer. If a water repellent is to be applied, an extra bath containing the repellent is added after the sour, the garments still remaining in the same washer. Since the repellents exhaust from the treating bath, the amount of repellent is proportioned to the dry weight of the garments. After the treatment the treating bath is discarded. Excess moisture is removed by centrifuging and the garments may then be dried in a tumbler with hot air, but if pressing is required, the drying will be accomplished during pressing. In this latter operation the temperature of the fabric may be considerably over 300° F., but only for a few seconds since all moisture must be removed gefore such temperatures can exist in the fabric.

Water repellents used in laundering processes are similar to many products used in textile finishing plants. They usually contain a wax and/or metallic soap, aluminum acetate or formate, an emulsifying agent, and sometimes a resin, and are slightly acidic. Products designed for use in laundry operations should not require prolonged high temperature curing operations.

In the event that the garment is drycleaned, it is more desirable to retreat it in an organic solvent such as Stoddard solvent for the garment can probably be handled more easily if it is not wet out with water. Products for such applications often contain waxes, metallic soaps such as aluminum stearate, and perhaps a resin. Such products should dissolve easily in Stoddard solvent at temperatures of 95° F., or less, and should remain in solution at temperatures down to 80° F. The flash point of the product should not be under 100° F., since this would lower the flash point of the solvent and create a fire hazard. Requirements for such products are covered well by Quartermaster Corps' tentative specification P.Q.D. 115c, dated 28 June, 1944.

Repellents in organic solvents do not exhaust from the treating bath, and thus the treatment must be carried out as a separate operation. It might be added that a repellent which would exhaust from the solvent would simplify the process by eliminating the extra operation. Retreatment is carried out as a separate operation after drycleaning. Sometimes it is done prior to drying after drycleaning, thus saving one drying operation and also conserving solvent, but if considerable repairing or stain removal is required it is best to apply the repellent after drycleaning, drying, stain removal and repairing have been accomplished. The operation involves three steps: immersion of the garments in the solvent solution of the repellent with a few minutes agitation, removal of excess solvent solution by centrifuging, and drying in tumblers into which the air enters at approximately 200° F. and leaves at 160° F.

The immersion in the solvent can be conveniently carried out in a small washer equipped with a pump to provide circulation of the solvent through a preheater and thus to prevent chilling of the solution, and precipitation of the repellent. Inasmuch as the repellents in an organic solvent do not exhaust on the fabrics, the solution should be used over and over again.

When the garments are removed from the washer they contain an amount of solution which is approximately 100% of their dry weight. Work done by the National Association of Dyers and Clean-

ers shows that after centrifuging, cotton will contain from 20 to 25% of its weight of solution whereas wool will contain only 10 to 12% of its weight of solution. Thus in treating fabrics in an organic solvent system, cotton will retain approximately twice the amount of repellent as does wool. The concentration of repellent in the treating solution must be adjusted so that there will be sufficient repellent remaining in the fabric with the percent solution retentions mentioned above. The solution which is removed by centrifuging is pumped back into the original treating solution. Of course the amount of repellent remaining in the fabric may be increased by not centrifuging the required time, or at the required speed, or even by not centrifuging at all. Unpublished work by the National Association of Dyers and Cleaners shows that such practices not only would increase the loss of solvent, but also by increasing the percentage of solvent fumes during subsequent dryings will create a fire hazard.

When garments are to be treated with a repellent in an organic solvent, they should be free from impurities such as soap, wetting agents, or hydroscopic inorganic salts. Such impurities will detract from the hydrophobic qualities of the treated material. Since many such impurities are not appreciably soluble in the solvent, they will not be removed from the fabric during drycleaning or immersion in the treating bath. Some Navy garments contain considerable amounts of the salts from sea water and must be rinsed in water before retreatment.

The practice of treating garments with a water repellent dissolved in Stoddard solvent has been known to the drycleaning trade for many years. In 1933 a formula was published (2) to the drycleaning trade employing paraffin and rubber cement. Several such products appeared prior to the war but not much was known concerning the application of such products to large volumes of work. In May of 1942, when the Army Quartermaster Corps required that Army Field Jackets be retreated after cleaning, considerable interest was aroused and many new products of this type appeared.

Today the organic solvent method of applying water repellents is little used in textile finishing plants and may be regarded as being in an experimental stage. Without attempting to take up the drawbacks of the organic solvent process in a textile finishing plant, such as the cost of additional equipment and solvent recovery units, one cannot help but see some definite possibilities for such a process. No emulsifying agent is required in products applied in organic solvents and thus formulation of such products should be somewhat simplified and no subsequent processes are necessary to dispose of any emulsifying agents after application of the repellent. Since such products go into solution or at least approach a true solution in the solvent, a small and uniform particle size can easily be maintained. Moreover, the fact that the repellents do not exhaust from an organic solvent allows the concentration of the treating solution to be easily controlled.

One of the most fascinating, and at the same time most important, phases of water repellent studies is that of the fabric itself. Most of the difference in performance of various water repellents is in variations of durability rather than in the initial hydrophobic qualities imparted to a fabric. Differences in fabrics, however, make tremendous variations in the performance of garments under actual conditions of wear. This has been an important consideration for the armed forces whose garments are required to withstand extreme conditions not often encountered by civilians. The contributions of the American Association of Textile Chemists and Colorists and of Slowinske (3) have pioneered such studies. Such work, along with that carried out during the past few years under the direction of the armed forces, has demonstrated several fundamental concepts which may aid in predicting the resistance of water repellent fabrics to water penetration and thus their performance during wear. A water repellent fabric will offer some resistance to the penetration of water. Because of its hydrophobic nature, water will have difficulty passing through the actual fibers, but instead will tend to pass through openings in the fabric. Obviously the smaller these openings, the greater will be the resistance to penetration of water and fabrics of considerable thickness will necessitate that water pass through numerous openings and thus have even greater resistance to penetration. The driving force striving to overcome this resistance to penetration is the energy of impact of the water drops on the fabric. The greater the impact of water on the fabric, the more rapid the penetration. The surface of the fabric must be firm enough so that the impact will be broken and the water cannot push the fibers aside and thus enlarge the openings. In general, this last condition is fulfilled if the fabric is tightly enough woven to have a low air permeability.

The above concepts may be more clearly illustrated by a few examples. If a water repellent fabric is placed over a smooth, hard surface, such as a board, and subjected to a spray of water it will soon be found that the water penetrates the fabric and wets the board. If another piece of the same material is placed over several thicknesses of rather soft material, and these fabrics then placed on the board, the repellent fabric on top, and subjected to an identical spray as that which had caused penetration in the previous example, the water will not penetrate the fabric and not even wet the under side of it. The reason for this is that in the second example the fabrics beneath the water repellent material served as a cushion and thus absorbed some of the impact of the water drops.

A water repellent fabric such as a poplin can be submitted to a water spray of sufficient velocity to penetrate it in a few minutes. If, however, a double thickness of poplin is subjected to the same spray, the time required for penetration will be not merely twice that required for the single thickness, but many times that length of time. In the case of the double thickness, the outer fabric breaks the impact so that by the time the water reaches the second layer of fabric there is very little driving force remaining. If instead of the double thickness of poplin, one piece of water repellent poplin is placed over a piece of water repellent flannel of the same weight, the time required for penetration of both fabrics will be many times that required for the penetration of the double thickness of poplin. In this case, the flannel with its napped surface offers a very intricate mesh of water repellent fibers which is highly resistant to water penetration. The flannel by itself would be of little value for its surface is not firm enough to resist the impact of the water which would merely push the fibers aside. When the poplin is placed over it to break the impact of the water drops, we have a combination of a firm surface and a thick fabric with very small openings.

A rather recent development in water repellent fabrics is the use of fabric constructions which allow excessive swelling of cotton yarns when wet and which thus brings about a sealing of the fabric. Such swelling is increased by low yarn twists. For example it was found that by lowering the twist in the filling yarns of Navy Jungle Cloth, the resistance to water penetration was increased several times. The most outstanding development along such lines has been the Shirley Institute Cloth (4) in which low twist, plied yarns are very tightly woven into an oxford weave. This cloth is quite superior in resistance to water penetration to other fabrics of comparable weight, which have come to our attention, for moisture causes the yarns to swell to such an extent that the

interstices are almost completely closed.

Such discoveries now make it possible to design water repellent garments which will perform excellently during actual wear, or to make minor changes in commonly used fabrics to increase water resistance. The study of fabric construction and its relation to resistance to water penetration has merely been begun. There are undoubtedly many additional concepts concerning resistance to water penetration which will be disclosed by future research. It certainly does not require great vision to believe that water repellent garments in the near future will not merely protect the wearer from a drizzle or light rain, but actually give adequate protection against heavy rains.

Such research in the performance of water repellent fabrics has necessitated developmental work in methods of testing. Here again Slowinske's contributions have been noteworthy (5). It must be borne in mind that there are several specific characteristics which are of interest in water repellent fabrics and one type of test cannot be expected to indicate all such characteristics. The following factors are of interest to the research worker: the hydrophobic characteristics of the material, the resistance to penetration of water when striking with given energy of impact, and the durability of the repellent.

The hydrophobic qualities of a fabric can be determined by well known laboratory tests such as the immersion test or spray test described in the American Association of Textile Chemists and Colorists Year Book. The results of such tests depend mainly on the efficiency of the water repellent treatment. Such tests are quite valuable as plant control tests.

Determination of the resistance to water penetration is of primary importance when several fabrics of different construction are being compared to determine their relative performance. Although such a test requires that a fabric have satisfactory hydrophobic characteristics it depends mainly on the construction of the fabric. Air permeability tests also depend on fabric construction but do not correlate with the resistance to water unless fabrics of similar construction are being compared. Numerous cases have come to our attention where fabric "A" has more resistance to air permeability than has fabric "B", but where fabric "B" will resist the penetration of water many times longer than fabric "A". In the case cited previously where two similar fabrics had much different resistance to water penetration by virtue of the difference in twist of the filling yarns, there was very little difference between the two fabrics in air permeability. As mentioned previously, placing a water repellent flannel beneath a water repellent wind resistant fabric, such as poplin, produces a double thickness system which will resist water penetration many times as long as the single thickness of poplin, but the double thickness system of poplin-flannel had practically the same air permeability as the single thickness of poplin.

One does not have to examine many fabrics of different constructions to find that the spray and immersion tests mentioned above do not correlate with the resistance of various types of fabrics to water penetration. Hydrostatic pressure tests at first may appear to be measuring resistance to water penetration but this is not necessarily so. When drops of water strike a fabric or a system of several fabrics, the energy of impact is greatest at the outer surface of the fabric and becomes less as the water passes through the material. Thus in the poplin-flannel example cited above, the flannel was subjected to very little energy of impact. In a hydrostatic test, however, the pressure forcing the water remains constant as the water passes through the fabric. Thus placing the flannel back of the poplin would have very little effect, except for a slight time lag, on the results of a hydrostatic pressure test. Fortunately, several test methods have been developed which evaluate a fabric's resistance to water penetration. One of these was developed by Dr. Milton Harris and his coworkers at the Textile Foundation. It is known as a "Drop Penetration Test." Another developed by Slowinske is known as a "Rain Tester", and was described at the March, 1944, meeting of the American Association of Textile Technologists. Both of these methods have been of great value to the armed forces in selecting and developing fabrics having more resistance to water penetration, and in making changes in the construction of existing fabrics for the same purpose.

Tests for durability of repellents in the past have been carried out by stimulating laundering and drycleaning processes in launder-o-meter jars followed by standard control tests to determine the loss of hydrophobic characteristics of the fabric. Recently the Army Quartermaster Corps has carried out extensive tests in which laboratory tests have been correlated with actual wearing performances of Field Jackets. This study has shown that laboratory methods can be used to predict accurately the durability of water repellent fabrics, and thus is quite a contribution to the science of evaluating water repellents.

The American Association of Textile Chemists and Colorists has shown great interest and has done remarkable work in the field of water repellent fabrics. There are many of our fighting men today, both on land and on sea, who are drier and thus more comfortable by virtue of your development work in this field. It is sincerely hoped that your efforts along these lines are continued in the future.

REFERENCES:

[1] National Ass. Dyers & Cleaners Bull. F1, May 25, 1940.
[2] National Ass. Dyers & Cleaners Technical Bull. 71, May 4, 1933.
[3] Slowinske, G. A., Am. Dyestuff Rptr. 32, P85-91 (1943).
[4] British patent 549974.
[5] Slowinske, G. A., Am. Dyestuff Rptr. 30, P2-8 (1941).

DISCUSSION

CHAIRMAN POWERS: Thank you very much, Lt. Fulton. Is it right that, on the basis of the present procedure of the dry cleaners, there is no such thing as a durable water repellent?

LT. FULTON: That is a good question. I would say that that depends on how many times the material must be dry cleaned, how hard it will be worn, how dirty it gets, and so on. A garment which will not be worn too hard and which will not be dry cleaned too often will retain a pretty fair degree of repellency; however, it might not meet the degree of repellency that the armed forces specify. As to the actual dropping off of water repellency with repeated dry cleanings, I suggest that you ask Colonel Steadman or someone from the Quartermaster Corps about that. I wouldn't want to be so discouraging as to say that there is no such thing as a durable repellent.

A. G. POPE: I would like to ask Lt. Fulton if the conventional dry cleaning equipment can be used for applying retreating compounds from solvent systems such as the Zorik system, for example, or the conventional Stoddard solvent system.

LT. FULTON: Water repellents can be applied in Stoddard equipment. Sometimes it is necessary to add a steam coil to warm up the solvent. They cannot be applied very well in the usual equipment used with chlorinated hydrocarbon solvents such as perchlor-ethylene for the reason that such equipment is usually constructed so that the washing operation and the centrifuging is done in the same cylinder. Thus it is necessary to drop the solvent to a tank which is connected with the still after each washing operation before the garments can be centrifuged. Thus it would be necessary to put in some piping and a separate tank, unless you wanted to lose a lot of water repellent; in other words, you wouldn't be able to use the bath over and over again as is done in Stoddard solvent. That is not a characteristic of the solvent, but

(Concluded on Page P104)

COTTON GROUP MEETING*

DOUGLAS C. NEWMAN
Presiding

THE chairman referred to the method of conducting the technical sessions and then called upon the first speaker who was Henry A. Rutherford, Research Associate of the Textile Foundation at the National Bureau of Standards, Washington, D. C.

. . . Mr. Rutherford's paper is not yet ready for publication but will be published when received. . . .

CHAIRMAN NEWMAN: Our next paper is titled "Recent Developments in the Application of Vat Dyestuffs." It will be delivered by Captain R. S. Stribling of the Philadelphia Quartermaster Depot. Captain Stribling!

. . . Captain Stribling then presented his prepared paper. . . .

RECENT DEVELOPMENTS IN THE APPLICATION OF VAT DYESTUFFS*

CAPT. R. S. STRIBLING

INTRODUCTION

I. A. Demands for a wider variety of fabrics possessing maximum fastness for military use have resulted in the introduction of several new methods of procedure in application of vat dyestuffs. These have potential value in adoption to civilian use in the postwar period. Also the new developments of vat dyeing have admirably fitted into the picture of procurement of vat dyed items required by the Armed Forces. There have been few fundamental changes over a period of years in the mechanical and chemical application of vat dyestuffs. It was first believed when vat colors were applied to cotton, that the dyestuff had to be in a reduced leuco state to be properly applied to get the maximum color value and the desired color fastness, very soon this theory was discarded to some extent in favor of the pad-pigment and jig reduction and oxidation, especially on heavier shades to better the fastness properties which was vastly improved by this method of fixation. Prior to the outbreak of the war in 1939 the dyeing of Government fabrics with vat dyestuffs was universally conducted according to the pigment pad-jig method. Up to that time and also subsequent to 1939, various attempts, successful or not, had been made to dye the cloth, cotton, herringbone twill 8.5 oz. used for fatigue clothing, with vat dyestuffs according to the conventional continuous method.

B. *The Chemistry of the Vat Dyeing Process.*—A typical vat color as manufactured might be represented by the simple formula: A—C= O. The "C=O" represents the chemically reactive portion of the dyestuff molecule, through chemical reduction of which the dyestuff is transformed temporarily into an alkali-soluble "leuco" derivative. The sodium salt of this "Leuco" derivative may be represented by the formula:

A=C—ONa

It will be noted that the "A" representing the major portion of the color molecule has remained unchanged, but the "C=O" has been converted to the sodium salt of a weak acid, thus imparting water solubility temporarily to the large molecule. The "leuco" derivative penetrates the cotton fiber and is retained within the fiber by its co-called "substantive" properties. After the uniform distribution of this "leuco" derivative through the fibers of a textile material, oxidation converts the "leuco" derivative back to the original vat color represented by A—C=O. However, the insoluble A—C=O now is distributed uniformly through the fibers in minute particles, retained in place by physical and chemical forces which resist removal by abrasion (cracking), washing, bleaching agents, and other destructive and chemical influences. Furthermore, because of the large surface area of these minute color particles, a uniform color effect is obtained through the textile; and because of the chemical nature of the vat color, this color effect exhibits excellent stability to light.

Many reducing agents have been employed for the conversion of the insoluble vat color to its "leuco" form, but the most economical and simplest reducing agent consists of sodium hydrosulfite plus caustic soda. In the customary vat color dyeing processes, the reduction with sodium hydrosulfite and caustic is conducted at 120-140° F., and the complete reduction of the insoluble color to the soluble "leuco" derivative has required a substantial period of time, usually 15 minutes to an hour or more, depending upon the nature of the specific process employed and the vat color selected. It has been known for years that the time of reduction can be reduced substantially by employing higher temperatures, but it also has been known that the "leuco" derivatives are not chemically stable at higher temperatures. The most important observation leading to the development of a new process was the fact that reduction of the vat color to the "leuco" on a fabric can be carried out completely in a matter of seconds at a temperature of 212° F., and that under these conditions, uniform distribution of the soluble "leuco" throughout the textile material also will take place in a few seconds. Furthermore, the chemical stability of the "leuco" at this temperature for the short period of time required for reduction and distribution (fixation) is entirely satisfactory.

Douglas C. Newman, Manager, Charlotte, N. C. Office, Organic Chemicals Dept., E. I. duPont de Nemours & Co., Inc., graduated from Randolph-Macon College in 1917. Following a year as chemist with the Federal Dyestuff and Chemical Corp. he joined the du-Pont company as colorist and technical demonstrator at the Technical Laboratory, Deepwater Point, N. J. In 1922 he went to Providence for du Pont where he served as salesman and technical demonstrator and in 1926 became assistant southern sales manager with headquarters in Charlotte, N. C. In 1941 he was appointed acting southern sales manager and in 1943 assumed his present position.

* Presented at Annual Meeting, Atlantic City, N. J., October 14, 1944.

PAD-STEAM PROCESS

II. A. The goal in the coloration of all textile materials is the production of a full range of attractive shades with maximum durability. It is accepted universally that the vat colors approach this goal more closely than any other class of dyestuffs on cotton and rayon textiles, and recent technical developments have extended the application of these dyestuffs to wool, acetate and mixed-fiber fabrics.

The dyer and finisher of textile materials always is confronted by the necessity for producing the finest products at the lowest cost. There is continuous research on color application and the development of new and improved methods of coloration. The results of these laboratory investigations are translated into practical processes, and the developments are made available to the color consuming industries to assist in the production of improved products.

A major investigation has been under way for some time directed toward the development of a continuous process for the application of vat colors to piece goods. The objective of this investigation may be summarized as follows:

(1) The new process should achieve minimum cost of application.
(2) The operation of the process should be simple and flexible, in order that it can be applied to the widest possible variety of fabrics in short as well as long yardages.
(3) The new process should produce color effects of the maximum fastness and best appearance obtainable with the vat colors.
(4) The new method should be applicable to the production of a full range of color effects from pastels to deep shades.

In attacking these ideal but seemingly difficult objectives, the first point of investigation obviously was the chemistry, physics and mechanics involved in applying vat colors to textile fibers. Cotton, of course, was selected as the first textile material for consideration.

E. *Development of the Fundamental Process.* The fundamental observations on reduction and fixation of vat colors at 212° F., stated above, indicated that if it were physically possible to deposit the vat color and reducing agent on a textile fabric and subject the fabric in the presence of moisture to a temperature of 212° F. for a short period of time, satisfactory fixation of the "leuco" derivative could be expected. Because the time required for the basic chemical and physical operations could be so short, a splendid opportunity was offered for continuous operation. The next steps of the study, therefore, were directed toward mechanical means of producing the desired conditions.

Capt. R. S. Stribling, Assistant to the Officer in Charge of Research and Development at the Philadelphia Quartermaster Depot, received his B.S. in Textile Engineering at Clemson and has been actively engaged in the textile field for the past twenty years. He has had experience as chemist, foreman of dyeing, and was for ten years superintendent of Southern Bleachery and Print Works, Inc. This plant handled cotton and rayon piece goods of fine fabrics in bleaching, dyeing, printing and finishing. Capt. Stribling is at present acting in an advisory capacity on problems related to the processes used in preparing, dyeing and finishing of cotton fabrics; also is assigned to a program on restricted items which requires a knowledge of the practical processing to obtain controlled fabrics for this purpose.

Without going into detail as to the numerous experiments and early failures, it will suffice to state that the desired combination of conditions was found. These conditions involved the following operating steps:

(1) Deposition of the vat color on the fabric by the pigment padding procedure.
(2) Drying the padded fabric.
(3) Re-padding the fabric with a solution containing sodium hydro-sulfite and caustic soda, plus an auxiliary material to suppress migration of the color. Suitable auxiliary materials were common salt or sodium formaldehyde sulfoxylate.
(4) Steaming the fabric for less than one minute at 212° F.

At the conclusion of these steps which can be operated in a continuous manner, the fabric is oxidized by any of the conventional processes to regenerate the vat color in its insoluble form, and then finished by the customary soaping, rinsing and drying.

C. *Laboratory Equipment:* A laboratory unit for the operation of the process was designed and constructed, then modified as experimental work progressed. Figure 1 is a schematic drawing of the laboratory unit in its final form. The legend accompanying the drawing indicates the various components of the complete unit.

The steam chamber ("F") is the only novel apparatus, and it differs from conventional steaming equipment only in the following mechanical and operating respects.

(1) The usual period of exposure of the fabric in this unit is less than one minute; in fact, 10-second steaming has been found sufficient in many applications of the process.
(2) An adequate supply of steam is required and a sufficient flow of steam is necessary to prevent the introduction of any appreciable quantity of oxygen (air) into the unit.
(3) Uniform distribution of the steam over the fabric surfaces is necessary to obtain uniform color development.
(4) Precautions must be taken to avoid dripping of steam condensate on the fabric, otherwise spotting of the dyeings may result.

It will be noted that partitions ("L") are provided in the bottom of the unit.

In certain modifications of the process, to be described later, small liquid developing baths ("Boosters") may be used in conjunction with the steaming for color development. The partitions make possible the utilization of one, two and three liquid boosters.

D. *Description of the Process:* The fabric to be dyed is prepared in the usual manner. For best results, thorough preparation of fabrics is desirable. The prepared fabric is pigment padded in the conventional manner in the padder ("B"). A two-bowl padded is shown, but for many fabrics, a three-bowl padder may be more satisfactory. The padded material is dried in the flue dryer ("C"). Any type of drying satisfactory for pigment-padded fabrics may be substituted for the flue dryer. Obviously, the fabric must be dried uniformly on both sides in order to avoid pigment migration.

The dried fabric is passed over a cooling cylinder ("D") then passed through a "chemical pad" on padder ("E"). This "chemical pad" consists of a solution of sodium hydrosulfite and caustic. To the "chemical pad" or to the pigment pad solution, common salt. Sodium formaldehyde sulfoxylate is added to suppress any migration tendencies. The cooling cylinder is included since the chemical padding should be carried out below 100° F.

The fabric passes from the "chemical pad" to the steam chamber ("F"), this distance being held as short as possible to avoid loss of reducing agent from the fabric due to air oxidation. The fabric is steamed for less than a minute in a saturated steam atmosphere at 212° F. or slightly higher. During this steaming the vat color is reduced and the "leuco" derivative is penetrated thoroughly into the fabric and fixed.

From the steam chamber the dyed fabric is subjected to conventional oxidation,

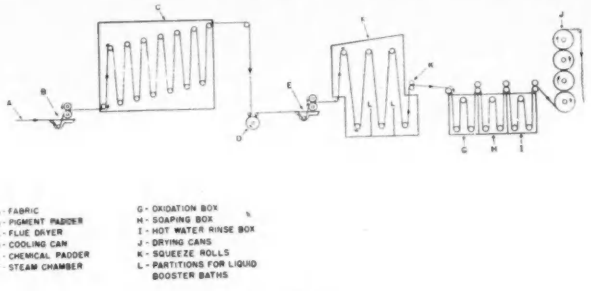
A - FABRIC
B - PIGMENT PADDER
C - FLUE DRYER
D - COOLING CAN
E - CHEMICAL PADDER
F - STEAM CHAMBER
G - OXIDATION BOX
H - SOAPING BOX
I - HOT WATER RINSE BOX
J - DRYING CANS
K - SQUEEZE ROLLS
L - PARTITIONS FOR LIQUID BOOSTER BATHS

FIGURE I

soaping, rinsing and drying. In the laboratory units, these operations are effected continuously in the three boxes designated G, H, I. In the first box the fabric is oxidized with sodium perborate, in the second it is scoured, and in the third it is rinsed. At this point the fabric is ready for drying by any suitable method. (On the accompanying sketch, drying is indicated on a can stack, but this equipment is not available in the laboratory unit.)

E. *Results Obtained by the Process:* Extensive laboratory application of this process to the full range of vat dyestuffs applied to a variety of fabrics justifies the general statement that shade, brilliancy, color value, clarity, and general appearance of the dyeings are equal to the best commercial work by conventional methods, such as pigment pad-jig application. Furthermore, the all-around fastness of the dyeings is equal to the best results obtainable by the methods now in operation. This includes fastness to light, abrasive washing, bleaching, and other destructive agents. This fastness is to be expected since a careful examination of the dyeings indicates excellent penetration and fixation of the dyestuffs.

F. *General Applicability of the Process:* The process has been applied successfully to cotton fabrics of virtually every type. It also has produced excellent results on rayon fabrics and on fabrics of mixed-fiber construction such as mixtures of cotton and rayon, cotton and wool, rayon and acetate, rayon and wool, and rayon-acetate-wool. There is every reason to believe that this method may be employed on all fabrics to be dyed with vat colors.

Of particular interest is the fact that pastel shades may be applied with very uniform results. Equally important is the fact that very deep shades of vat colors may be applied without difficulty, a serious limitation of the existing continuous methods. All vat colors may be applied by this process. Experimental work also indicates that the process is applicable to the continuous dyeing of sulfur colors and indigoids. It is expected also that the pad-steam technique will find wide application in the dyeing of other classes of dyestuffs to textile materials.

G. *Advantages of the Process:* The advantages of the new pad-steam process may be summarized as follows:

(1) The full range of vat colors may be applied continuously in pastel to very deep shades to a full range of fabrics.

(2) Appearance, color yield, and fastness properties of dyeings obtained by this method are equal to the best commercial work by current methods.

(3) Substantial savings in cost of color application are realized by the new process.

(4) The process may be operated on short or long yardages. There is no expense for booster baths and the usual effort required to establish the composition of booster liquors and in setting up new shades is eliminated.

III. *Reduced Pad followed by Development in Boiling Soda Ash Booster.* This process is being used for dyeing cloth, cotton, herringbone twill, and similar fabrics. The goods padded with reduced vat colors are run into a closed chamber, the upper portion being an atmospheric steam phase and the lower a reduction bath with soda ash as the alkaline medium. The goods are alternately immersed in the developing bath in the lower and exposed to steam in the upper parts of the chamber. No appreciable bleed off of color is obtained and the total volume of the booster is only about one-sixth that of the conventional continuous dyeing process.

The steps of the operation are as follows:

(a) Reduced padding of the fabric.

(b) Development in the steam chamber with auxiliary liquid boosters in the compartments as previously described.

(c) Oxidation, soaping, rinsing, and drying.

Considerable experience has been acquired on the operation of this process and the following general conclusions can be stated as to the results obtainable:

(a) Color value, appearance of dyeings and fastness are at least equal to those obtained by the conventional continuous methods.

(b) Excellent results may be obtained with fabrics which have had little preparation prior to dyeing.

(c) Substantial economies in costs of application may be effected by this method.

IV. A. *Reduced Pad—Rope Development.* This method was originally developed for the production of terry toweling dyed Vat O.D. No. 3 for the U. S. Army, as number of towel plants found their dyeing capacity out of balance with the rest of their plants when called on to produce large poundages of solid colored goods when they had been set up to take care of the average amount of colored work required by the civilian trade.

Many millions of yards of the material have been dyed by this method as well as a considerable yardage of huck toweling for the Army. The method has since been modified somewhat and adapted for the production of solid shades on specialty lines of materials such as fancy towel, mixed cottons and synthetic fiber goods and has also produced satisfactorily samples of Vat O.D. No. 3 on knit underwear tubing.

The process is based on the use of a soda ash booster method of development where the goods are padded with the vat leuco in the usual manner in a caustic and hydrosulfite solution and then passed directly into a development bath. Bleeding is reduced to a minimum and with some anthraquinone colors is so slight that additions of color to set up an equilibrium in the bath at the start of the run are unnecessary. With a caustic soda re-reduction bath there is of course a very definite bleed-off which requires the addition of definite amounts of color at the start of the run to set up the proper equilibrium and prevent tapering on the run.

This lack of bleed off gives a developing bath that is practically free of color and thus eliminates dye streaks due to uneven wetting or squeezing of the goods in rope form, the development bath merely serving to extend the reduction time of the color on the fiber between padding and oxidation.

As applied in practical use, a regular padder is set up in direct connection with either a reel type slack washer or a dye beck and so arranged that the goods, padded in the open width are passed directly into the developing washer, through a pot eye and over a "V" reel. From this point they pass through the machine in the usual manner getting a re-reduction treatment of about 4-5 minutes, and then pass to a second beck or washer where they get a cold water wash, are air oxidized, soaped, rinsed and ready for open-

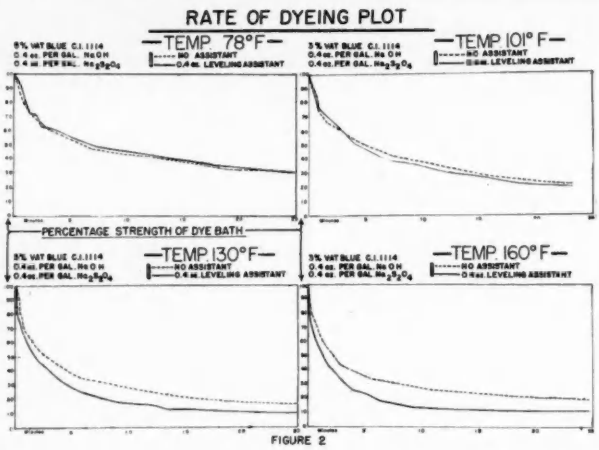

FIGURE 2

ing and drying.

B. *U. S. Army Duck.* Another adaptation of the soda ash method has been in use in the production of vat dyed number ducks for the U. S. Army for a considerable length of time. Unsized number duck may be and is being dyed from the grey bale by padding the goods directly into a reducing bath containing 2.0 oz. per gallon of caustic soda and 2.0 oz. per gallon of sodium hydrosulfite, at a temperature of 160° F., and then on into a soda ash developing bath, containing:

2.50 oz. per gal. sodium carbonate
4.00 oz. per gal. common salt
4.50 oz. per gal. sodium hydrosulfite

The immersion time of the pigment pad may be varied to suit the requirements of the particular plant, reduction time for 30 seconds and a development time of about two to two and a half minutes satisfactory results are obtained on unmercerized grey goods. The controls are maintained in the usual manner for the soda ash booster. Satisfactory penetration and fastness are obtained on number ducks by this method plus the usual advantages of continuous dyeing.

V. A. *Pigment-Pad Dried and Reduced Process.* The pigment color is padded and can be dried by the following methods: drying can, tenter frame, or on hot flue or other similar equipment. The hot flue method of drying yields the best results, with the least migration of color during the drying operation. This is particularly true on constructions which have no face. Can drying may be used, but in this event it is necessary that the first stack of cans have steam pressure of no more than one-quarter pound. Lapping of cans is none too satisfactory. Furthermore, in can drying there is great danger of rubs showing up very plainly after the reduction operation. A combination of running over cans and tenter frame drying have obtained excellent results by running over a set of eight dry cans with one-half pound steam pressure and then onto long tenter frame. This method is favorably compared to the results obtained with hot flue drying method.

Reduction Pad. A three bowl pad is much more satisfactory than a two bowl pad in order to obtain the proper yield of the dyestuffs. The pad box is relatively large and is equipped with guide rolls. Time in this box is relatively high, and particular care must be exercised in maintaining a uniform concentration of caustic soda and hydrosulfite during the run in order to eliminate shading difficulties. Uniformity in concentration can easily be maintained by making periodic titration tests.

Booster Box. Definite concentration of caustic soda and hydrosulfite in the booster boxes must be controlled as explained above. The advantages of this method over the regular reduced method of dyeing are:

a. Larger pigment pad mixer can be made up. When the reduced method of dyeing is used it is customary to limit the amount of reduced color on account of the color being very unstable and tend to deteriorate on standing.
b. Much less shading results from the use of this method of dyeing.

CONCLUSIONS

VI. A. New continuous methods for dyeing textile materials with vat colors have been developed. These new processes utilize steam as the fixing agent; and the time required for color reduction and fixation has been reduced to a matter of seconds. The results obtained by these methods are equal to the best obtainable by existing processes.

B. The continuous reduced pad—rope development process has increased the production, in comparison with the conventional reel method which require considerably more time in handling the same yardage on the various fabrics dyed by this method.

C. The continuous pigment-pad h flue or can dryed and reduced and oxidiz method has enabled heavy fabric to h dyed by this process with satisfactory fa ness for the purpose they are to be use

D. The use of vat colors on military an civilian textile products will be increase because of the ease of operation of th new processes, the excellent color effect obtained, and the unprecedented low co of application of the vat colors.

VAT DYEING OF YARN ON PACKAGES

VII. The vat dyeing of yarn in package form has rapidly increased in importance. The trend towards the production of dyeings with better levelness on larger packages in a shorter time by simpler processes at a lower overall cost has been facilitated by recent developments.

Larger Packages. Originally, the 12 oz. package was generally used for vat dyeing. Now 20 to 24 oz. packages are common. At times, 32 oz. packages are dyed. The successful dyeing of larger packages has been made possible by improved winding machines, package formers, higher rates of flow of the dyebath through the packages, a wider variety and improved quality of dye types, a wider range of dyeing assistants, and a more scientific knowledge of the dyeing process.

Better Levelness: In the early stages of the package dyeing art, a fairly level dyeing was adequate for the stripe effects for which such yarn was chiefly used. Today much package dyed yarn is used in knitting and for solid filling in woven goods and practically perfect levelness is demanded.

Modern winding machines, carefully maintained and operated by skilled personnel under close supervision, supply packages of substantially uniform density throughout each package and from package to package.

Larger capacity pumps circulate the dyebath faster through the packages and minimize the tendency of slight differences in package density to cause unlevel dye lots. Higher rates of flow assist in counteracting unlevelness due to inherently high exhaust rates of some dyes or different exhaust rates of the component dyes in a compound shade.

The increased range and improved quality of the vat dyes available in normal times permits the selection of the correct dyes to meet each specific problem of the level dyeing.

In the few cases where normal dyeing formulas fail to produce level dyeings there now is available a larger range of dyeing assistants to modify the inherent dyeing behavior of specific dyes. Most of these assistants have little effect on the rate of exhaust but they do decrease the

ultimate exhaust and the dye retained in the bath has a chance to reach the less easily accessible portions of yarn. Recently, new types of assistants have appeared which exert a powerful effect until at the end of the dyeing period, as full or nearly as a full shade is obtained as though no assistant had been used. Dyeing assistants for a specific problem must be carefully chosen since their behavior is usually quite specific to individual dyes and none of them are a panacea for all ills. (See Figure 2.)

Recent developments in scientific methods of studying the dyeing process have enabled the dye manufacturers to obtain very accurate data on exhaust rates, diffusion rates, etc. Such data applied to practical problems of the dyeing industry assist in the production of satisfactory dyeings.

The use of the modern highly developed Pigment Dyeing Method instead of the Reduced Dyeing Method has been found to solve many practical problems where excellent levelness and penetration were difficult to secure.

Shorter Dyeing Time. A dyeing period of four to as long as eight hours has been required in the past in order to produce satisfactory vat dyeings. Many dyehouses using a highly developed Pigment Method have cut this dyeing time considerably, and a large volume of production is requiring as little as two hours per dye lot. Contributing to this shorter dyeing time are better wound packages, higher rates of flow, improved quality of dyes, accurate knowledge of the inherent properties of the vat dyes, and adequate supplies of water and steam.

Simpler and More Foolproof Process. The high temperature, high rate of flow pigment method minimizes the effect of those factors such as non-uniform packages, inherent undesirable dyeing characteristics of many dyes, complicated procedures, operating personnel of only moderate skill, etc., which cause trouble in the customary reduced methods.

Illustrative of advanced commercial practice using the Pigment Method and Modern equipment is the following procedure:

Material: 400-20 oz. packages of 50s/3 ply mercerized yarn weighing 500 lbs. and wound on ⅝" jacketed fiber tubes.

Machine: Stainless Steel. Yarn to bath ration—1:10. Rate of flow—4 gal per package per minute.

Procedure. Pigment Method

Vat Dye (ultra-fine celloidized type)
Double Strength—2 per cent Soap Flakes (low titer)

Dissolve the soap flakes with soft water in the expansion tank, add one half of the dispersed dye and circulate outside—in 3 minutes at 180° F.

Add the rest of the dye and circulate inside-out 2 minutes at 180° F.

Circulate 5 minutes more
Add 4 per cent caustic soda flakes (dissolves)
Add 2 per cent sodium hydrosulfite
Circulate 10 minutes at 180° F.
Add 3 per cent common salt and circulate 5 minutes
Add 6 per cent common salt and circulate 5 minutes

Turn on the cold water and rinse inside-out, running the overflowing effluent to the sewer until the pH has dropped below 9.0; about 20 minutes.

Close drain, add 1 per cent hydrogen peroxide (100 volume) and heat to 140° F. while circulating.

Add 1 per cent soda ash and 2 per cent soap flakes, heat to 200° F. and circulate 20 minutes. Drain and rinse twice at 200° F., 5 minutes each time.

Total circulating time=1½ hours
Actual elapsed time =2 hours

Lower Cost. Decreased dyeing costs result from a lower chemical consumption which results from more accurate knowledge of the quantities required, the accelerating effect of high temperature on chemical reactions, and the elimination of expensive assistants saving their cost and increasing the color yield. The shorter dyeing time and the greater poundage per package also decrease the dyeing cost.

Improved Equipment. Stainless steel construction eliminates cleaning time between dye lots.

Improved and larger pumps give a higher rate of flow and maintenance cost has been decreased.

Improved carriers and spindles permit a higher rate of flow and a more equalized flow to all packages.

Improved tubes are available to those concerns which wind, dye, and backwind their own yarn. The commission dyehouse usually must stick to the ⅝" fiber tube which has become standardized in the trade.

The increase in rate of flow on a ⅝" tube machine requires a much greater increase in pump pressure and therefore in power consumption than does the same increase in rate of flow on a 1⅝" metal tube machine.

Improved rinsing devices permit the flushing of the system with clean water with all effluent going to waste and none recirculating.

Auxiliary equipment such as winders, extractors, and dryers is now available which is designed to contribute to the success of the dyeing rather than to have a detractive effect upon it as did some of the earlier models.

DISCUSSION

CHAIRMAN NEWMAN: Thank you very much, Captain Stribling.

We are indeed quite fortunate in having with us this morning a large number of technical representatives of the various dyestuff manufacturers who have had a considerable amount of experience in the practical application of vat colors. These gentlemen have agreed to assist us in the discussion.

I also see present quite a large number of men who have been in textile plants, either textile manufacturing plants or finishing plants, who have had a tremendous amount of experience on this subject.

E. H. TOBINS: I would like to ask a question about dyeing blues and greens in this method. Are you able to get sufficient brightness?

CHAIRMAN NEWMAN: Are you referring to the steam method?

MR. TOBINS: Yes.

MR. VIEIRA: You can dye without trouble.

MR. TOBINS: Will you get adequate color yield?

MR. VIEIRA: Yes.

HAROLD M. CHASE: Captain Stribling referred in the paper to a retarding agent, which lost its retarding action at the end of the operation. That has been a subject that has been of great interest to everybody in dyeing packages, that the retarding agent should retard at the beginning, and at the end should lose its retarding properties.

Is there a product of that sort on the market? It was talked about in England some years ago.

O. W. CLARK: There is such a product that was submitted to us for trial, not made by my company, and we have run tests on it and it does act in that manner. It is an ester, exhibiting its maximum effect at the beginning of dyeing, gradually hydrolyzing and losing its effect.

EDWARD KONRETH: I would like to know if you would have a lot of trouble in the condensation of the steam in that continuous process?

MR. VIEIRA: You use a steam heated chest or high pressure closed coils on top of the chest to get rid of the condensation. With the big machine there is no difficulty in getting rid of it at all.

LADISLAUS BALASSA: In the flue drying, is it necessary to completely dry the goods to prevent pigment migration?

CHAIRMAN NEWMAN: Are you referring to the steam process?

MR. BALASSA: Yes, the steam process, in which the flue drier was used.

CHAIRMAN NEWMAN: But not the steam phase used?

MR. BALASSA: I am just interested in the drying.

S. H. WILLIAMS: It is not necessary to completely dry the goods, as long as you have control of the drying. It has been worked out carrying the goods as low as probably 65 or 70 per cent drying, leaving 30 per cent moisture in the goods, as long as you control that phase of the operation.

HOMER WHELCHEL: I would like to know the correct amount of flow going through a package that weighed about a pound and a half.

MR. CLARK: It is very difficult to generalize, in dyeing, as you know, and give a rate of flow that would apply to all colors and all sizes, and so on. But the best commercial machines today are running around four gallons per package per minute, which will take care of practically all conditions.

Some work has been done which suggests a little higher rate of flow, perhaps six gallons per package per minute is more ideal, when you are running with pound and a half packages. A great many of the older machines have entirely too low rates of flow. They run down to one or two gallons per minute, or even less, and it makes it necessary to use all kinds of dyeing dodges in an attempt to get levelness.

The gist of all this work that has been done is, that it is much easier to eliminate dyeing troubles by increasing the rate of flow than by any other method that you can use. Perhaps the real answer is not to attempt to get too high a rate of flow, because of the cost of the original installation, plus operating cost, but to get a sufficiently high rate of flow that would take care of maybe 95 or 98 per cent of your dyeing, and for the other one or two that might give trouble, to use a leveling assistant or whatever other dodge is necessary.

MR. BALASSA: Just what mechanical arrangements have been made to keep continuous dyeing continuous if change of color is intended? Naturally they would have to wash the padders or that would not be continuous, or is there a way of switching to another padder?

CHAIRMAN NEWMAN: You mean running from one shade to another?

MR. BALASSA: Yes, to another shade. It was said that that method is continuous with regard to change of shade. I mean, it would enable change of shade, wouldn't it?

MR. VIEIRA: I didn't quite get the drift of the question.

MR. BALASSA: Just how do you keep continuous dyeing continuous if you intend to change the shade?

MR. VIEIRA: Naturally we have to stop off and clean up a little bit. By these new methods there is much less cleaning up to be done and much less change.

MR. BALASSA: I see. There is no way to change from one to another padder without interruption of the process?

MR. VIEIRA: No, sir, not that I know of.

The remainder of the papers presented at the Cotton Group Meeting will be published in the next issue.

FINISHING GROUP MEETING

(Concluded from Page P98)

merely the way that equipment is constructed.

HAROLD C. WOOD: I would like to know if you know any way to re-dye any of the durable water repellent fabrics. Is that a fair question to ask?

LT. FULTON: I have never been connected with any efforts along that line. When I left the National Association of Dyers and Cleaners, I guess water repellent fabrics of a durable type were not old enough to need re-dyeing. I certainly don't know any more about it than you folks would know. I would think a suitable wetting agent would allow proper re-dyeing.

CHAIRMAN POWERS: Is Mr. Slowinske here? What about re-dyeing water repellent fabrics?

GEORGE A. SLOWINSKE: Answering that question is like answering the question about durability to dry cleaning. You can re-dye. First, you wet the fabric with a wetting agent, soap, or synthetic, and then rinse it, and then proceed with your re-dyeing job. That can be done in a laboratory on all types of garments, but it hasn't been worked out on a textile mill scale.

Incidentally, with reference to your question on the durability of finish in dry cleaning, Lt. Fulton really gave you the answer in his talk. The durable repellent will stand up better to dry cleaning than the non-durable; that is, all your repellency will not be destroyed, even with one, or two, or three, or four dry cleanings; you will destroy non-durable repellents with one dry cleaning. Also, the durable will show up better when retreated than the non-durable.

CHAIRMAN POWERS: Of course, the point he also made in his talk was that dry cleaners, being dry cleaners, frequently use soap in their dry cleaning, which is the thing, of course, that does the damage, I presume, in the subsequent operation.

LT. FULTON: I don't know exactly what does the damage; many factors may cause damage.

CHAIRMAN POWERS: One other point: In your tests there you frequently use a flannel. Isn't it true in your performance, unless you have a waterproof fabric on your head, the waterproof fabric is always on a soft surface that will give, so that the flannel is a factor that shows up in a test, but not in performance nearly as much; I mean, a raincoat is usually against your shoulder?

LT. FULTON: That is right, although a person might wear a poplin golf jacket without much under it on a hot day.

CHAIRMAN POWERS: But even then you would have some give.

LT. FULTON: That is right. It is something which must be considered mainly in methods of testing. I think if such tests are standardized there will have to be a measure of the actual kinetic energy of the water and the compressional resilience of the material so as to arrive at the energy of impact that actually is absorbed by the material.

JOSEPH A. WOODHEAD: I haven't made these tests, but when you say the soap is retained and affects the water repellency, after-treatment of this washing in warm or cold water will take out that soap; during subsequent drying it will come back to its original water repellency. Have you tried that?

LT. FULTON: Yes. It will restore it to some extent. Such a procedure may be all right where a dry cleaner sees he has made a mistake on a single garment and goes back and corrects it; however, in cases where large tonnages are being handled, he will not go back and wash the whole lot to get that soap out. He might as well have washed it in the first place.

Lt. G. P. Fulton, S. C., U.S.N.R., Bureau of Supplies and Accounts, Washington, D. C., graduated from Dickinson College in 1931 and received his M.S. in Chemistry from Penn State in 1933. Prior to naval service he was Technical Director of the National Association of Dyers and Cleaners, Silver Springs, Md. His present duties are connected with the renovation of used Navy special clothing.

OBITUARY

HUGH A. ROSS

HUGH A. ROSS, who had been affiliated with Sandoz Chemical Works, Incorporated, as a technical demonstrator, died January 10th, 1945.

A native of Scotland, he was born November 17th, 1896 and attended schools there. While studying engineering at the Glasgow University, he enlisted in the Royal Engineers during World War I.

Coming into this country in 1920, he settled first in Lowell, Mass., working at the Lowell Textile Works and attending the Lowell Textile School. Subsequently he was affiliated with M. T. Stevens and Sons and the Merrimac Manufacturing Company as well as the Merrimac Woolen Mills. He came with Sandoz in 1936 and demonstrated for them mostly in the New England area.

Mr. Ross was a member of the AATCC. Besides his widow, he leaves four children.

• JOINS UNITED MERCHANTS

E. P. Johnstone has resigned as a member of the research staff of the American Cyanamid Company and joined United Merchants and Manufacturers Management Corp., New York City, where he will be engaged in textile and chemical research.

Mr. Johnstone was with American Cyanamid for five years, having been stationed at their Stamford, Conn., laboratories and later at the Calco Chemical Division at Bound Brook, N. J. Prior to that he had been with the Farr Alpaca Co., Holyoke, Mass.

• A NEW DIKETONE

Carbide and Carbon Chemicals Corporation, a unit of Union Carbide and Carbon Corporation, now is producing in commercial quantities an unusual, reactive diketone—pentanedione-2, 4(acetylacetone)—which is expected to stimulate considerable interest in the pharmaceutical, dyestuff, metal-refining, and photographic fields. This diketone contains an active methylene group which is the foundation of much of its chemical reactivity and produces some unusual condensation products. It is a valuable starting material for the preparation of a variety of compounds of interest as pharmaceutical and dyestuff intermediates, solvents, plasticizers, insecticides, resin stabilizers, corrosion inhibitors, and "sulfa" drugs.

Pentanedione condenses readily with aniline to form a product that can be dehydrated to 4-methyl quinaldine, which in turn can be used in the manufacture of important carbocyanine dyes. These dyes are widely employed as sensitizers in color photography. Dyestuffs similar to the Hansa yellows are formed when pentanedione is condensed with aromatic diazo compounds. This diketone also condenses with quanidine to form the important "sulfa" drug intermediate 2-amino-4,6-dimethyl pyrimidine.

In addition to pentanedione, Carbide and Carbon Chemicals Corporation can supply development quantities of other interesting 2,4-diketones possessing greater hydrocarbon solubility and lower water solubility than pentanedione. Information on pentanedione can be obtained by requesting Form 5725 from Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York 17, N. Y.

• JOINS OAKITE PRODUCTS

Dr. Donald Price, who for the past year has been connected with Interchemical Corp., New York, N. Y., in charge of research in pharmaceuticals and fine chemicals, and who for many years previous was Director of the Organic Research Laboratory, National Oil Products Co., Harrison,

Donald Price

N. J., has been appointed Technical Director of Oakite Products, Inc., New York, N. Y., effective February 1st, 1945. Dr. Price is vice-president of the American Institute of Chemists, a councilor of the American Chemical Society, and vice-chairman of the technical program committee of the New York Section of the American Association of Textile Chemists and Colorists.

In his new capacity, Dr. Price will head Oakite's Technical Division comprising its Research Laboratory, Technical Service and Technical Information Departments. The company plans to expand its technical service facilities to the various branches of the textile industry it serves.

• JOINS TEXTILE SERVICE

Charles L. Parker has joined the technical staff of the Textile Service and Chemical Corp., 6 North Street, North Quincy 71, Mass. Mr. Parker was formerly associated with the Aspinook Corporation both in Lawrence and Jewett City. Previous to that time he was employed by the Print Works Division of Pacific Mills.

Mr. Parker's duties will include the introduction of the company's chemical specialties as well as field work in the proper application of new finishes soon to be released.

The technical staff of this company now includes, in addition to Mr. Parker, Ewald Trost, chief chemist and John G. Parker, Jr., chemist in charge of plant production.

• EXPORT SERVICE BUREAU

Establishment of an Export Service Bureau in New York, with a receptionist speaking both Spanish and French to welcome visitors from abroad, was announced today by the Foreign Relations Department of E. I. du Pont de Nemours & Company.

The receptionist appointed is Miss Maria Llaverias, who has been with the Du Pont Company four years, having been employed in the Organic Chemicals Department, the Grasselli Chemicals Department, and the Cellophane Division of the Rayon Department. The office will be on the 11th floor of the Empire State Building adjacent to the present reception room of the Rayon Department.

• RIEGEL DEVELOPMENT LABORATORIES

J. L. Riegel, Chairman of the Board of The Trion Company, Riegel Textile Corporation and Ware Shoals Manufacturing Company and Bleachery, announces the formation of the Riegel Development Laboratories, Inc. to coordinate their research and development activities.

J. F. Warner, president of the Laboratories, is in charge of the newly established organization, whose headquarters will be at 342 Madison Avenue, New York 17, New York. Before joining the Riegel organization in 1944, Mr. Warner had been for a number of years with the American Cyanamid Company, as vice-president of their subsidiary, the Calco Chemical Company, and later as Director of Development.

• JOINS O. F. ZURN

The O. F. Zurn Company, Quaker City Chemical Division, Philadelphia, Pa., an-

nounces the addition to their technical and sales staff of J. H. Callicott, formerly connected with the Se-Ling Hosiery Mills. He will be associated with W. S. McNab in the Southern plant and office in Knoxville, Tenn., as assistant southern manager.

● **NATIONAL CARBON OFFICERS**

C. O. Kleinsmith has been elected a vice-president of National Carbon Company, Inc., a unit of Union Carbide & Carbon Corporation. Mr. Kleinsmith was formerly general sales manager for the company's

C. O. Kleinsmith

"Eveready" products. Prior to his appointment to that position, two years ago, he

D. B. Joy

was sales manager for Eastern United States. He joined the company in 1919.

Mr. Kleinsmith announced the appointment of D. B. Joy as general sales manager for Carbon Products. Mr. Joy joined National Carbon Company in 1923 after graduating from Massachusetts Institute of Technology. He was made director of the company's Process Engineering Laboratory at Fostoria, Ohio, ten years ago, and in 1941 became assistant superintendent of the Fostoria factory. He was made product manager last year.

Mr. Kleinsmith also announced the appointment of R. P. Bergan as general sales manager for the company's consumer and related products.

● **MILTON HARRIS LABORATORIES**

Milton Harris and Associates announ the opening of research laboratories serve the textile and allied industries 1246 Taylor Street, N.W., Washington D. C.

● **OFFICERS, WATSON-PARK CO.**

Watson-Park Co., 261 Franklin Stre Boston, Mass., have anounced the follo ing as officers and members of the orga zation:

Kenneth B. Park, *President.*
Howell F. Shepard, *Treasurer.*
M. L. Daymond, *Assistant Treasurer.*
Arthur Grimes, *Auditor.*
Philip E. Mason, *Chief Chemist an Purchasing Agent.*

Frederic A. Prisley, *Director of Research.*

H. Raymond Wilkinson, *Technica Demonstrator.*

SALESMEN

Howard V. King, *Rhode Island an Connecticut.*

William H. Ogden, *Vermont, New Hampshire and Eastern Massachusetts.*

Victor C. Bushman, *Maine and Centra Massachusetts.*

Alex T. O'Brien, *Western Massachusetts.*
John Cahill, *Southern U. S.*
Alexander Day, *Western U. S.*

• CLASSIFIED ADVERTISEMENTS •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $6.25 per column inch or less per insertion.

POSITION WANTED: Twenty years experience in dyeing and finishing of skein and package dyeing. Past fifteen years overseer of dyeing with large corporation. Make own formulas. Desires position as assistant superintendent or manager. Full information on request. Box 652.

WANTED: Selling Agents on commission basis covering textile industry; also to sell sizings and gums for New York importer. Give particulars as to territorial experience, etc. Also lucrative side line. Box 653.

POSITION WANTED: Hosiery Dyer, with several years experience both technical and practical, capable of handling any hosiery dye job. Not employed as dyer at present. Box 654.

WANTED: TEXTILE ENGINEER. Excellent opportunity in essential industry for a young man with research ability in engineering. Permanent responsible position with reliable progressive textile manufacturer. Development program requires initiative. State age, training and experience. Include photo. Box 655.

WANTED: Manufacturing chemist or plant foreman to take charge of production in plant manufacturing textile chemical specialties; such as, sulphonated softeners, soaps, detergents, sizings, etc. Plant located in South. Products rated as war essential. Box 656.

WANTED: TEXTILE CHEMIST: Position with good future in research and development laboratory of substantial cotton and rayon textile finishing concern in New England. In addition to textile experience, particularly in dyeing and finishing, should also be well trained in organic chemistry. Draft exempt. Send details and snapshot in first letter. Box 657.

WANTED: TEXTILE CHEMIST, (female) with experience in testing for permanent position in New York Laboratory. Write Box 658.

NOTE

Essential employees need release statement. Employees who are to be hired for critical occupations need release statement and U. S. E. S. consent.